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Nuclear Science Abstracts

Covering the Literature on Atomic Energy
in the Fields of

Biology Medicine Chemistry
Biophysics Physics Engineering
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Vol. 5 No. 7
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NP-1777(p.85-90)	Nuclear Chemistry (Organic) Group, p.85-90 of [Seventeenth] Progress Report; [July 1, 1949, to July 1, 1950]. J. D. Roberts.	1539
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NP-1814	Technical Report No. 2. C. T. Lane.	1579
NP-1819	Progress Report 2 on Fluorescence and Conductivity Phenomena. Hartmut Kallmann.	1574
NP-1853	Critical Constants, Boiling Points, Triple Point Constants and Vapor Pressures of the Six Isotopic Hydrogen Molecules, Based on a Simple Mass Relationship. Abraham Solomon Friedman, David White, and Herrick L. Johnston.	1541
NP-1858	First Quarterly by Progress Report for the Fiscal Year 1950-1951. Columbia Radiation Laboratory.	1572
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NP-1934	Progress Report 3 on Fluorescence and Conductivity Phenomena; July, August, September, 1950. Hartmut Kallmann.	1575
NP-2157	Electron Pair Production During Radioactive Decay; trans. from Zhur. Eksptl'. i Teoret. Fiz. VII, No. 6, 696-713, June, 1937. B. V. Tiissa.	1592
NRL-3680	Surface Chemical Phenomena in Lubrication. J. E. Brophy and W. A. Zisman.	1546

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ONRL-71-50	Geophysical Research at the University of Rome. Thomas Coor.	1552
TT-124	The Kinetics of Desorption of Activated Adsorbed Hydrogen; trans. from Zhur. Fiz. Khim. 23, 897, 1949. N. P. Keier and S. Z. Roginskii.	1532

GENERAL

ATOMIC BOMBS AND WARFARE

1439

IF A BOMBS FALL. Edward J. Kehoe and Francis L. Brannigan. Natl. Safety News, 78-9, 155-8(1950) Oct.

The possibility of atomic bombs being used against the United States is considered. A basis for civil defense is set up by indicating that a fireman might absorb 500 times the amount of radioactivity allowed workers in atomic energy plants. This is due to the fact that the plant workers are exposed to cumulative effects over years of time. The fireman would not be continuously exposed. Also it is shown that radioactivity in itself is not necessarily lethal or even harmful if acquired in small amounts such as in cosmic rays or from a radium-dial watch. An analysis of a bomb blast indicates: in the air, maximum blast effect and radiation emanation; in water, damage to ships and harbors; underground, about the same effect as an earthquake over areas of 3000 to 6000 ft in diameter.

ATOMIC POWER

1440

Brookhaven National Laboratory
ATOMIC ENERGY. Alan M. Thorndike. Sept. 8, 1950. 14p. (AECU-1077)

A nontechnical discussion of the present-day production and utilization of nuclear fuels, the scope of the atomic energy programs of the various nations engaged in this work, the principles of the hydrogen bomb, and international implications of production of atomic weapons.

1441

CONTRIBUTIONS TO THE PERSPECTIVE OF THE USE OF ATOMIC POWER IN ARGENTINA. H. Freimuth. Rev. inst. nacl. invest. cienc. nat. anexo museo argentino cienc. nat. "Bernardino Rivadavia," cienc. geol. 1, No. 1, 1-64 (1949). (In Spanish)

This work presents the principles of nuclear transformations and deals especially with the problem of fission and of the pile. The question of world sources of energy—coal, oil, natural gas, wood, hydraulic power, and atomic energy—is considered, and probable sources of power in the year 2000 are discussed. Information is given about fissionable materials, particularly about the problem of uranium supply. The price per kilowatt-hour on a basis of coal, steam, and atomic power is discussed from the economic standpoint, and the benefits which Argentina could realize in the field of atomic research are shown. 65 references. (auth)

1442

DEVELOPMENT OF ATOMIC ENERGY—HOW CAN PRIVATE INDUSTRY BEST PARTICIPATE? Philip Sporn. Nucleonics 8, No. 2, 9-12(1951) Feb.

Satisfactory power production and development by conventional means, higher efficiency in steam power plants, the fact that nuclear power is not a new kind of power but (to industry) only a new kind of fuel for producing heat, and exclusion from information and opportunity are indicated as reasons for the lack of participation by industry in the development of atomic energy.

1443

POWER FROM THE ATOM—AN APPRAISAL. C. G. Suits. Nucleonics 8, No. 2, 3-8(1951) Feb.

From an appraisal of costs of power from atomic energy and from present-day steam plants it is concluded that a combination of high fuel and transportation costs coupled to requirements for large blocks of power might enhance the case for the use of nuclear power plants. Justification for present development of atomic power is based on military potentials.

BIOLOGY AND MEDICINE

1444

Agricultural and Mechanical College of Texas
THE BIOCHEMICAL CONVERSIONS OF CONJUGATED DIENOIC AND TRIENOIC FATTY ACIDS. Raymond Reiser [nd.] 15p. (ORO-17)

Ingested conjugated linoleic acid by the hen makes its appearance in the egg. In subsequent eggs, the acids undergo spectrophotometric changes similar to in vitro oxidation. The maximum at 233 mμ gradually disappears and a broad absorption band in the region of 270 mμ makes its appearance. The changes are more pronounced in the phospholipid acids of the eggs than in the neutral fat acids. Ingested eleostearic acid by the laying hen appears in the neutral fat of subsequent eggs along the large quantities of a newly synthesized dienoic acid. That the metabolic activity of the

phospholipids is greater than that of the neutral fat is evidenced by the observation that typical absorption curves of eleostearic acids are not as prominent in the phospholipids as in the neutral fat, but larger amounts of the new dienoic acids are present. (auth)

RADIATION EFFECTS

1445

BIOLOGICAL ACTION OF FAST ELECTRONS FROM A 6-MEV BETATRON. Wolfgang Paul and Gerhard Schubert. Z. Naturforsch. 5b, 390-4(1950) Oct.-Nov. (In German)

The action of fast electrons (up to 6 Mev) on various biological objects was compared with that of hard x rays (200 kv). In the majority of cases observed (growth inhibition in barley sprouts, mitosis-frequency changes in root-end cells of barley and horse beans, killing of Drosophila eggs and pupae) the effect per dose unit is smaller when produced by electrons. On the other hand, no difference is observed in the radiation-induced development of lethal factors in mature or immature male cells of Drosophila or in the simpler forms of chromosome breakings produced by radiations in the same insect. Only in the case of the killing of Bacterium coli do electrons show the greater effect per unit dose. These results can be interpreted in the light of the "hit" theory. (auth)

1446

Atomic Energy Research Establishment
THE CALCULATION OF THE ENERGY DEPOSITION IN SOFT TISSUE BY FAST NEUTRONS WHEN THE CROSS SECTION VARIES AS $1/E^{1/2}$ WITH ENERGY E. J. H. Tait. Sept. 1950. 12p. (AERE-T/R-564; HD-397)

A method is described for the calculation of the energy deposition in soft tissue or in any other hydrogenous material by fast neutrons. The method consists of determining the energy deposition curve from high Mellin transforms of the neutron flux with respect to velocity. These latter quantities are evaluated assuming that the mean free path is constant.

1447

CHANGES IN THE RELATIVE PROPORTIONS OF DIFFERENT AXIAL SKELETAL TYPES WITHIN INBRED STRAINS OF MICE BROUGHT ABOUT BY X-IRRADIATION AT CRITICAL STAGES IN EMBRYONIC DEVELOPMENT. Liane B. Russell and W. L. Russell. Paper presented at the 1950 Meeting of the Genetics Society of America, Columbus, Ohio, Sept. 11 to 14.

An abstract of this paper appeared in Genetics 35, 689(1950) Nov. and is reproduced here in its entirety.

An extensive study on the effects of single doses of x rays on (C57 × NB) F_1 hybrid mouse embryos, at stages ranging from days ½ to 13½ after fertilization, revealed that the critical period for a posterior shift in the thoracolumbar border was from days 7½ to 9½, with day 8½ exhibiting peak sensitivity. Two strains, one (129) showing considerable natural variability in number of presacral vertebrae and the other (B alb C) showing natural variability in this and in the thoracolumbar border, were chosen, as being probably more sensitive than the specified uniform hybrids, for an extensive dosage-comparison study. Almost 600 newborn mice irradiated during the critical period with doses of 25, 50, 100, or 200 r and 647 controls have been obtained. In the B alb C, an increase in fourteenth-rib development occurs with 25 r on day 8½, is greater with 50 r, and complete with 100 or 200 r. (Number of sternebrae and number of ribs articulating with the sternum are also increased, but correlation with the thoracolumbar shift is incomplete.) Both B alb C's and 129's, whose normal presacral complement is 26-or-27 and 25-or-26, respectively, are shifted toward the higher number by irradiation on day 8½ (50 and, possibly, even 25 r) and, less markedly, on days 7½ and 9½. As had been anticipated, in strains where there is no natural variability, characters are considerably more resistant to radiation-induced shift. This is true of the position of the thoracolumbar border in strain 129 and of the presacral number in the (C57 × NB) F_1 hybrid.

1448

DEVELOPMENTAL EFFECTS OBSERVED IN HABROBRACON AFTER EXPOSURE TO BETA RADIATION. J. N. Dent and Robert L. Amy. Growth 14, 113-21(1950) June.

Developing individuals of H. juglandis were exposed to various levels of beta radiation for 48-hr periods just before hatching or during the early larval period. At the highest levels of radiation used, the wasps died before hatching or in the larval stage. At intermediate levels death usually occurred during pupation with a considerable degree of inverse correlation between the extent of imaginal differentiation and the amount of radiation given off. At the lowest levels it was apparent that most of the animals attained adult form. The rate of development was somewhat reduced at the highest and intermediate levels but not at the lowest levels. Pupation without cocoon formation was a frequent occurrence at the intermediate levels. Evidence which indicates that irradiated animals reaching adulthood were sterile is presented. (auth)

1449

THE EFFECT OF ANOXIA ON X-RAY-INDUCED INJURY IN MELANOPLUS DIFFERENTIALIS EMBRYOS. Theodore N. Tahmisian and Dorothy M. Adamson. Paper presented at the 47th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio, Dec. 27-30, 1950.

An abstract of this paper appeared in Anat. Record 108, 516(1950) Nov. and is reproduced here in its entirety.

Melanoplus differentialis grasshopper embryos placed in an atmosphere of N_2/CO_2 (95%/5%) for 24 hr developed normally. If these anoxic embryos are irradiated at 25,000 r after 24 hr of anoxia and placed at 25°C in air, negative growth does not occur as with eggs irradiated in air. Upon interrupting diapause by cold treatment for 3 months, when returned to 25°C these embryos irradiated under N_2/CO_2 unlike those irradiated in air show development. Namely, they undergo blastokinesis, increase in size, resting nuclei appear normal, respiration is normal, mitosis resumes, the embryos grow, and the oxidative enzyme due to x radiation does not appear. These do not hatch, however. Since any oxygen which is dissolved in the egg is theoretically used up in ½ hr the irradiation effect on these embryos under N_2/CO_2 is in complete metabolic standstill. Evidently, in orthoptera no anaerobic glycolysis takes place, so that no

form of energy release known to us is possible. Since the oxygen substrate moiety is interrupted, we may regard metabolism stopped, and under such conditions irradiation damage is at a minimum.

1450

EFFECT OF RADIATION FROM INTRAPERITONEALLY INJECTED RADIUM CHLORIDE UPON MEGAKARYOCYTE AND BLOOD PLATELET PRODUCTION IN ALBINO RATS. Paul G. Roofe, Hal Bingham, Ralph Comer, and Martha Madison. Paper presented at the 47th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio, Dec. 27-30, 1950.

An abstract of this paper appeared in Anat. Record 108, 537(1950) Nov. and is reproduced here in its entirety.

Twenty-five rats were divided into groups of five, each group receiving respectively 10, 20, 30, 40, and 50 μg of $RaCl_2$ intraperitoneally. One rat from each group was sacrificed every 3rd day starting 3 days postinjection. Using a camera lucida, quantitative megakaryocyte counts were made from slides prepared from intact bone marrow of the femur. The platelet counts were made using a hemocytometer and a 2% sodium citrate diluting fluid. Megakaryocytes decrease progressively with time through the 9th day after injection of $RaCl_2$. From this period to the 14th day, a trend toward regeneration was noted. The lowest number of megakaryocytes was observed in animals receiving 20 μg independent of time of sacrifice. Regeneration appeared earlier in the higher dosages. Following an initial increase of platelets on the 3rd day, there was a progressive decrease up to and including the 14th day. Regardless of time, higher dosages also produced a decrease from the normal. The initial destruction of the megakaryocytes is reflected on the 3rd day by an increase in platelets. As the megakaryocytes regenerate it appears that platelet production does not correspond quantitatively, presumably because young megakaryocytes do not fragment.

1451

EFFECT OF SLOW CATHODE RAYS ON MICROORGANISMS. Walter S. Moos. Nucleonics 8, No. 1, 50-3(1951) Jan.

The influence of very slow electrons (1 to 8 kev) on Pseudonomas aeruginosa has been studied. Results show a maximum effect of the electrons at a voltage that gives them a penetration in depth corresponding to the cell diameter. (auth)

1452

THE EFFECT OF X IRRADIATION ON FIGHTING BEHAVIOR IN MALE MICE. Howard H. Vogel, Jr. Paper presented at the 47th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio, Dec. 27-30, 1950.

An abstract of this paper appeared in Anat. Record 108, 547(1950) Nov. and is reproduced here in its entirety.

These experiments were carried out to test the effects of chronic x irradiation upon fighting behavior. Male mice (5 weeks old) of three strains, C-57 black, C-3H agouti, and CF-1, were kept in isolated cages and were trained to fight in a multiple-escape pen. Six males were trained to become aggressive, whereas, under the conditions of the experiment, fighting was inhibited in their daily opponents. After the trained fighters had defeated a dozen other males of their strain, they were irradiated daily with 50 r of x radiation, 5 days a week, and fighting was continued daily. The body weights of the irradiated fighting mice were compared with those of nonirradiated controls over a period of approximately 15 weeks. The accumulated x-ray dosage given to each of the six experimental mice at the time all fighting ceased and at the time of death are given. The effects of x irradiation upon fighting behavior in male mice were cumulative. Each fighting mouse retained its characteristic method of attack up to the day when all fighting ceased. There was a definite threshold after which no fighting occurred, but before this threshold the irradiated fighters defeated their daily opponents. The aggressiveness of the attacks decreased as the cumulative x-ray dose increased. The conditioning that the mice had received was strong, and it took a large dosage (1200 to more than 2000 r) to eliminate it completely. All signs of fighting were not suppressed until shortly before the death of the irradiated animal.

1453

EFFECT OF X-IRRADIATION ON HEMOLYSIN DECLINE. William H. Taliaferro and Lucy Graves Taliaferro. J. Infectious Diseases 87, No. 3, 201-9(1950).

X irradiation in 2 doses of 400 r to the entire body of rabbits during the decline of hemolysin 2 to 4 weeks after immunization with one or a series of intravenous injections of sheep red cells did not alter the downward trend of the titer as compared to controls not irradiated. Three intravenous injections of ovalbumin 9½, 11, and 12 weeks after immunization only elicited a possible heterologous anamnestic response to red cells in 1 of 7 rabbits. (auth)

1454

EFFECTS OF OXYGEN TENSION ON X-RAY INDUCED MITOTIC INHIBITION. Mary Esther Gaulden and Marjorie Nix. Paper presented at the 1950 Meeting of the Genetics Society of America, Columbus, Ohio, Sept. 11 to 14.

An abstract of this paper appeared in Genetics 35, 665(1950) Nov. and is reproduced here in its entirety.

The large neuroblast cells of the embryo of the grasshopper Chortophaga viridifasciata were given 64 r of x rays while exposed to different tensions of oxygen, namely, 100%, 21% (air), 2%, and 0% (nitrogen, carbon dioxide, or vacuum). The embryos were made into culture preparations. The number of cells in mid-mitosis (prometaphase, metaphase, and anaphase) was recorded every 22 min for 6 hr after treatment. Thus the number of cells completing mitosis in a given period of time was determined, since 22 min is the average duration of mid-mitosis (at 38°C) and since the treatments used do not affect this duration. The results indicate that the sensitivity of mitosis to radiation is reduced when cells are irradiated at the lower oxygen tensions. In other words, the duration of the period of complete mitotic inhibition (period after irradiation during which there are no cells in the mid-mitotic stages) is shorter when cells are irradiated in 0 or 2% oxygen than when they are irradiated in 21 or 100% oxygen. Experiments are now in progress to determine the sensitivity of cells to radiation in 5 and 10% oxygen.

1455

THE EFFECTS OF RADIATION ON THE PREIMPLANTATION STAGES OF THE MOUSE EMBRYO. Liane Brauch Russell and W. L. Russell. Paper presented at the 47th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio, Dec. 27-30, 1950.

An abstract of this paper appeared in Anat. Record 108, 521(1950) Nov. and is reproduced here in its entirety.

Irradiation during preimplantation (cleavage) stages causes high prenatal mortality but only a negligible incidence of abnormalities in animals surviving to term, the relative magnitude of these two effects being the reverse of that found following irradiation of postimplantation stages. To determine time of death, inbred females which had received 200 r on day ½, 1½, 2½, 3½, or 4½ after mating were dissected on day 10½ or 13½ of gestation. A control was handled simultaneously with each irradiated female. Altogether 831 embryos and resorbing bodies were observed. In overall effect, the earliest stages are more sensitive: the average number of living embryos per treated female is approximately 20% of the controls in groups irradiated on days ½, 1½, or 2½, but 31 and 57% following treatment on days 3½ and 4½, respectively. In groups irradiated on days 2½ and 3½, the major part (81 and 53%, respectively) of the reduction in live embryo count is accounted for by death after implantation; whereas in groups irradiated on day ½, 1½, and 4½, the majority of the deaths (71, 71, and 75%, respectively) occurs before implantation. Postimplantation death probably occurs considerably before day 10½. The main or sole expression of preimplantation death is on entire litters in groups other than those irradiated on day ½ or 1½ where 39 and 22%, respectively, of the preimplantion death is due to selective mortality within litters. Total-litter death may be due to radiation effect on the mother rather than direct lethal action on embryos.

1456

THE EFFECTS OF RADIOACTIVE PHOSPHORUS ON CRICETUS AURATUS. A. Martin. Paper presented at the 1950 Meeting of the Genetics Society of America, Columbus, Ohio, Sept. 11 to 14.

An abstract of this paper appeared in Genetics 35, 679(1950) Nov. and is reproduced here in its entirety.

Males of the golden hamster, Cricetus auratus, have been given intraperitoneal injections of various dosages of radioactive phosphorus and subsequently mated to untreated females. Histological and cytological examination of the tissues of the treated animals is in progress, and progeny are under observation. The maximum sublethal dose lies between 6 and 9 μc/g of body weight. A few animals survive a dosage of 8 μc, and recover from radiation sickness in about 11 days. Three microcuries induce permanent sterility in 30 days or less. Dosages of 3 or more μc result in the degeneration of Sertoli cells and the filling of the seminiferous tubules with fibrous connective tissue. One microcurie has no effect on sperms in the tubules in 24 hr, but in 15 days the tubules are devoid of sperms. In 30 days, however, the testes again appear normal, and the tubules contain apparently normal sperms. Following dosages of 1 and 3 μc, the white blood cell count is much reduced. No statement is as yet available on effects on other tissues. The available progeny to date bear out the histological and cytological findings, in that none has been produced by males treated with 3 or more μc. When not completely destroyed, the germ plasm seems to be remarkably stable, in that progeny show no phenotypic abnormalities, litter size is unaffected, and offspring are of normal viability.

1457

EFFECTS OF RADIO-PHOSPHORUS (P^{32}) ON MITOSIS IN LARVAL TAIL-TIPS OF AMBLYSTOMA PUNCTATUM. Donald P. Costello and Catherine Henley. Paper presented at the 47th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio, Dec. 27-30, 1950.

An abstract of this paper appeared in Anat. Record 108, 578-9(1950) Nov. and is reproduced here in its entirety.

Young larvae (of appropriate age) of Amblystoma punctatum, from which tail-tips had been clipped, were permitted to degenerate in media containing various concentrations of radiophosphorus. The exact dosage of β radiation within the epithelial cells of the regenerating tail-tip cannot be calculated, but a sufficient range of dosage was used to give variations in effects on mitosis from zero to complete inhibition. Submaximal dosages produced a wide variety of mitotic abnormalities, some types of which have never before been observed by the authors with other types of treatment. Many deletions (production of chromosome fragments) resulted similar to those induced in classical plant material, such as Tradescantia, by irradiation. Several extreme multiple deletions were obtained, showing 30 or 40 or more chromosome fragments within a single cell. There was a paucity of multipolar mitoses among the abnormalities produced by the irradiation. Multipolar mitoses are among the most common of the mitotic anomalies produced by temperature effects. The demonstration that Amblystoma punctatum larval tail-tips are a favorable material (comparable, in some respects, to Tradescantia) for the study of the effects of radioisotopes on cells and mitosis is of considerable importance. Investigations of the effects of radiations on animal cells have lagged considerably behind similar work on plants, due largely to a lack of suitable material. Tail-tips of 580 treated larvae have been studied to date, with adequate numbers of controls.

1458

EFFECTS OF VARYING OXYGEN TENSION ON MORTALITY OF X-RAYED MICE. George Limperos. J. Franklin Inst. 249, 513-14(1950) June. (Note)

Oxygen tension is reported to play an important part in the biological effects of x radiation. The production of H_2O_2 and HO_2 and the "release" of the OH radicals from a back reaction may account for increased mortality of mice x rayed under a higher-oxygen atmosphere. The low-oxygen atmosphere exerts a protective effect possibly because it decreases the concentration of OH and HO_2 radicals and of H_2O_2.

1459

THE INCIDENCE OF STERILITY AND PARTIAL STERILITY IN THE DESCENDANTS OF X-IRRADIATED MICE. W. L. Russell. Paper presented at the 1950 Meeting of the Genetics Society of America, Columbus, Ohio, Sept. 11 to 14.

An abstract of this paper appeared in Genetics 35, 689-90 (1950) Nov. and is reproduced here in its entirety.

The data reported here were obtained incidentally in the course of another investigation. Adult male mice were given a single, whole-body, 80 r/min dose of 500, 750, or 1000 r, and then were mated. Twenty-two male and 15 female offspring, all conceived within 2 to 30 days after irradiation of the sire, were tested for fertility. Averaging the results over wide dose ranges is not justifiable, because of nonlinearity of effect with dose, but is perhaps permissible, over the range used here, for a rough comparison with the results of other workers. Of the 37 animals tested, and whose sires received a mean dose of 669 r, 8.1% were found to be completely sterile and 27.0% partially sterile. These percentages are in remarkably close agreement with the results of Snell and Hertwig for similar dose ranges. All of the 10 partially sterile animals obtained in this experiment, and one other from another test, were found to transmit partial sterility to some of their descendants. Two of the 11 lines, however, do not fit the simple interpretation of reciprocal translocation which Snell and others have established as the cause of the partial sterility in at least some cases. Both of these lines are producing some completely sterile descendants, one also yielding some almost sterile descendants. The data obtained so far are not adequate to determine whether a different type of change is involved or whether an additional translocation or other chromosomal or gene change has occurred.

1460

THE INDIRECT ACTION OF X AND ULTRAVIOLET RADIATION. Z. M. Bacq. Experientia 7, 11-19(1951) Jan. 15. (In French)

Recent literature and the author's experiments favor strongly the general idea that the action of ultraviolet and x rays on enzymes, cells, and organisms is not entirely a direct one, that chemical substances (peroxides in the case of ultraviolet rays, oxidizing short-lived free radicals in the case of x rays) resulting mainly from the action of rays on water molecules, are really the responsible agents. The greatest part of the action of ultraviolet or x rays is indirect. It is possible, by injection of cyanide, azide, cysteine, glutathione, thiourea, etc., to decrease very significantly the death rate of rats or mice irradiated with x rays, but only if the substance is injected before irradiation; so far, the biochemical lesion of x irradiation has been found irreversible. (auth)

1461

THE INFLUENCE OF POLYPLOIDY ON THE X-RAY SENSITIVITY OF CELLS. C. J. Bishop. Paper presented at the 1950 Meeting of the Genetics Society of America, Columbus, Ohio, Sept. 11 to 14.

An abstract of this paper appeared in Genetics 35, 654(1950) Nov. and is reproduced here in its entirety.

A study of comparative sensitivity to x radiation has been made by treating developing microspores and pollen grains of diploid and tetraploid species of Tradescantia with equal doses of x rays. Treatments were given at a time just previous to the prophase of the pollen-grain division and at a stage before chromosome doubling in the generative-nucleus division. The aberrations produced were analyzed at the pollen-grain division and the pollen-tube division, respectively. Results indicate that the sensitivity of the two types of cells is the same if the comparison is based on the number of x-ray-induced breaks per chromosome. A comparison of the number of breaks per cell shows that the cells from the tetraploid plants have approximately double the number of breaks found in those from the diploid plants.

1462

INFLUENCE OF THYMECTOMY, SPLENECTOMY, AND GONADECTOMY ON INCIDENCE OF RADIATION-INDUCED LYMPHOID TUMORS IN STRAIN C57 BLACK MICE. Henry S. Kaplan. J. Natl. Cancer Inst. 11, 83-90(1950) Aug.

Mice of strain C57 black were thymectomized, splenectomized, or kept as intact controls and treated with fractionated whole-body roentgen rays at 1 to 2 months of age. The technique of thymectomy is described in detail. Of 23 thymectomized mice, 1 (4%) developed a lymphoid tumor at 440 days after irradiation. Tumors appeared in 13 (57%) of 23 splenectomized and 10 (48%) of 21 control irradiated mice at mean intervals of 184 and 197 days, respectively, after irradiation. It is concluded that thymectomy effectively prevents the development of radiation-induced lymphomas. In another experiment with mice of the same strain, animals were gonadectomized and litter-mates kept as intact controls. All were exposed to fractionated whole-body roentgen rays at 1 month of age. Lymphoid tumors occurred in 11 of 14 intact males (79%), 15 of 18 intact females (83%), 19 of 22 castrate males (86%), and 16 of 20 spayed females (80%). The mean induction times were, respectively, 262, 244, 215, and 234 days after the start of irradiation. These differences in incidence and mean induction time are not significant at the 0.05 level.

1463

IONIZING RADIATION AND BLOOD-FORMING TISSUES. J. Am. Med. Assoc. 144, 1182-3(1950) Dec. 2. (Editorial)

Certain aspects of the effects of irradiation on hematopoietic tissues and protection against radiation mortality are reviewed. 8 references.

1464

A PHASE CONTRAST MICROSCOPY STUDY OF X-RAY-INDUCED PYCNOSIS IN THE LIVING CELL. Theodore N. Tahmisian and Dorothy M. Adamson. Paper presented at the 47th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio, Dec. 27-30, 1950.

An abstract of this paper appeared in Anat. Record 108, 572-3(1950) Nov. and is reproduced here in its entirety.

The effect of x radiation ranging from 25,000 to 200,000 r can be kept latent in Melanoplus differentialis grasshopper embryos for 6 months by maintaining them at submetabolic temperatures. If diapause eggs are irradiated and left at 25°C, pycnosis of the nuclei takes place by 8 days. When the eggs are irradiated and placed immediately at 0°C and kept at this temperature for 6 months no morphological or physiological changes are observed upon returning them to 25°C. However, pycnosis occurs by 8 days at 25°C, depending not only on the irradiation dosage but also on the metabolic

activity of the cell. Pycnosis in the living cell as observed by phase-contrast microscopy resembles fixed material morphologically. Physiologically there is a difference in the physical state of the nuclei when observed in the living condition. Most nuclei show a drop in viscosity at the time of pycnosis as judged by the increase in Brownian movement. Vital staining with Janus green indicates that the mitochondria usually clump as a separate body, whereas the chromatin material becomes pycnotic containing lipoid-impregnated bodies.

1465

RADIANT ENERGY. Abraham Edelmann. Ann. Rev. Physiol., 27-46(1950).

A brief review of the literature and discussions of the following are included: radiation safeguards; measurements; mode of action of radiation on tissue; effects on blood; and effects on other tissues. 172 references.

1466

THE RELATION BETWEEN INDUCED MUTATION AND RETARDATION OF CELL DIVISION BROUGHT ABOUT BY ULTRAVIOLET IRRADIATION OF PARAMECIUM AURELIA. R. F. Kimball. Paper presented at the 1950 Meeting of the Genetics Society of America, Columbus, Ohio, Sept. 11 to 14.

An abstract of this paper appeared in Genetics 35, 673(1950) Nov. and is reproduced here in its entirety.

Specimens of Paramecium aurelia which had been exposed to 2650-A monochromatic ultraviolet were isolated, and the nonhereditary retardation of cell division was measured as time to the sixth division. After recovery from this effect, some of the descendants of each of the original irradiated animals were allowed to undergo autogamy to make them homozygous and so bring to light any genetic effects. The per cent of exautogamous clones of reduced vigor was taken as a measure of the latter. Time to the sixth division was found to be uncorrelated with per cent of reduced vigor within groups of animals exposed to the same dose. Both retardation of cell division and reduced vigor after autogamy are subject to photoreactivation; so it is possible that both are due, at least in part, to some one primary effect of ultraviolet which is subject to photoreactivation. Even if such a common step does exist, variations in it cannot be the cause of the individual differences in the response of paramecia exposed to the same dose. These differences must be due to causes which act independently upon the hereditary and nonhereditary components of the ultraviolet effect.

1467

SOME CASES OF RADIATION INJURY IN RADIOLOGICAL WORK. S. Hultberg, L. E. Larsson, and L. Eklund. Acta Radiol. 33, 376(1950) Mar.-Apr.

This paper was abstracted in Arch. Ind. Hyg. Occupational Med. 3, 223(1951) Feb. with considerably greater detail than in the present note. In Sweden all lesions due to radiological injury must be reported to the Institute of Radiophysics. The radiation injuries that have been brought to the attention of the institute have been of two kinds, local injuries and blood damage. The authors present the histories of eight patients who sustained such injuries either in their daily work or from an overdose during radiography.

1468

SPONTANEOUS AND INDUCED CHROMOSOME ABERRATIONS IN THE GRASSHOPPER CHLOEALTIS CONSPERSA. K. H. Rothfels. Paper presented at the 1950 Meeting of the Genetics Society of America, Columbus, Ohio, Sept. 11 to 14.

An abstract of this paper appeared in Genetics 35, 687(1950) Nov. and is reproduced here in its entirety.

The incidence of spontaneous chromosome aberrations in first meiotic metaphases of Chloealtis males is estimated to be 0.1 incomplete breaks, 0.01 complete breaks, and 0.01 interchanges per cell. After an x-ray dose of 100 r the following classes of induced chromosome aberrations come successively into maximum: (1) incomplete breaks (24 hr), (2) "stickiness" (5 days), (3) complete breaks (10 days), (4) interchanges (15 days), (5) incomplete nuclei (17 days). Over the range 2 to 300 r, 0.05 incomplete breaks are obtained per nucleus per r. If the dose-effect curve remains linear at even lower doses, natural ionizing radiations cannot account for more than 1% of the spontaneous abnormalities of this type. Similar conclusions were obtained with regard to the complete breaks and interchanges. These findings were tested directly by exposing grasshoppers at various distances from a Co^{60} source for 20 days. A dose rate of 500 × background was required to produce a clearly significant increase in chromosome aberrations over control animals.

1469

X-RAY INDUCED SOMATIC CROSSING OVER IN DROSOPHILA MELANOGASTER. George Lefevre, Jr. Paper presented at the 47th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio, Dec. 27-30, 1950.

An abstract of this paper appeared in Anat. Record.108, 623-4(1950) Nov. and is reproduced here in its entirety.

Eye color mosaics were produced by irradiating larval stages of Drosophila with 1300 r at the rate of 59 r/min 48 hr after egg laying. The mosaic incidence in heterozygous white females was 0.65 per eye. In similar females, but also bearing a double inversion in one X chromosome, the mosaic incidence was 0.06 per eye. In males an incidence of less than 0.02 white mosaics per eye was found. In males, mosaics result mainly from somatic mutation; in females, deletion, chromosome loss, translocation, abnormal disjunction, and somatic crossing over also may produce mosaics. The presence of inversions should not alter the effectiveness of any of the mosaic-producing mechanisms, except the last. Thus, in normal heterozygous females the great majority of mosaics result from somatic crossing over, or possibly from nonhomologous segmental interchange. The distribution of induced somatic crossovers was studied by comparing the mosaic incidence in heterozygous white (locus 1.5), heterozygous garnet (44), and heterozygous carnation (62.5) females. The results indicate that an appreciable amount of somatic crossing over must take place in the heterochromatic portion of the X chromosome; but it is not equally distributed throughout the X chromosome, being greater in the right than in the left end. A similar distortion of the normal pattern of crossing over

is found when various agents are used in order to induce excessive germinal crossing over.

RADIATION HAZARDS AND PROTECTION

1470

University of Chicago Metallurgical Laboratory
RADIATION PROBLEMS OF THE CHEMICAL PLANT. L. B. Borst and E. O. Wollan. Dec. 12, 1942. Decl. May 15, 1950. 8p. (AECD-2978; CP-378)

Absorption measurements have been made in a large body of water to evaluate the contribution to the radiation intensity produced by the degradation of radiation without absorption. Radiation intensities three times those expected from simple exponential absorption were found. Scattering from the air of gamma radiation has been measured and has been found to agree satisfactorily with theoretical predictions. The penetration of radiation through curved pipes in shielding has been measured and has been found to be a flat topped function. A 2-in. pipe bent in the arc of a circle of 7-ft chord, and a 10-ft radius gives a reduction of intensity over the intensity in air at the same distance of 2.5×10^4.

1471

Brookhaven National Laboratory
SENSITIVITY OF LIQUID WASTE MONITORING BY THE EVAPORATION METHOD. Frederick P. Cowan and John V. Nehemias. [nd.] 18p. (AECU-985)

In a widely used method for determining the radioactivity of liquid wastes, a sample is evaporated to dryness and the activity of the solid residue determined by counting. A statistical criterion for the sensitivity of this method has been derived, and is applied to an evaluation of minimum detectable concentrations of certain radioactive substances in the effluent from the Brookhaven National Laboratory sewage processing plant. The minimum detectable concentrations for P^{32} (500-ml sample volume) was found to be 1.6×10^{-8} μc/cc; for C^{14} (500-ml sample volume), 1.8×10^{-7} μc/cc; and for Po (200-ml sample volume), 3.0×10^{-9} μc/cc.

1472

Oak Ridge National Laboratory
QUARTERLY PROGRESS REPORT FOR PERIOD ENDING OCTOBER 20, 1950; HEALTH PHYSICS DIVISION. K. Z. Morgan, Director. Dec. 11, 1950. 18p. (ORNL-877)

Brief reports on the following are included: a constant water monitor and other instrument developments, radioactive waste disposal research, empirical evaluation of effective atomic number, dispersal of stack gases, backscattering and fast-neutron monitoring, radiochemical analyses, tests on the response of a fast-neutron dosimeter, etc.

1473

ESTIMATING RADIOELEMENTS IN EXPOSED INDIVIDUALS. I. RADIOELEMENT METABOLISM. Jack Schubert. Nucleonics 8, No. 2, 13-28(1951) Feb.

The discussion covers aspects of the solution chemistry of cationic radioelements, mechanisms for determining metabolism, ion exchange uptake by bone, colloidal adsorption uptake by bone, rate of incorporation in bone, blood disappearance, soft-tissue deposition, body elimination of radioelements, metabolism after inhalation, and treatment of radioelement poisoning. It is concluded that in case of entrance of radioelements into the body, treatment should be started as soon as possible. In the case of excessive amounts of orally ingested radioelements, the appropriate treatment should minimize absorption from the intestinal tract (by use of precipitating agents) and hasten elimination. 63 references.

1474

Chemical Corps School, Army Chemical Center
HANDBOOK FOR RADIOLOGICAL DEFENSE SUBCOURSES. Nov. 1949. 103p. (NP-1913; RDS-1B; NAV PERS 10852)

This text was prepared and published by the Chemical Corps School for joint use by the Department of the Army, Department of the Navy, and Department of the Air Force for instruction by correspondence of members of the civilian components and the Regular Establishment. Sections on the following are presented: signs and symbols; mathematical tables; atomic and nuclear tables; glossary; dimensions, units and conversion tables; formulas; and graphs and charts. A table of constants and miscellaneous conversion data are included.

1475

MAXIMUM PERMISSIBLE AMOUNTS OF RADIOISOTOPES. Nucleonics 8, No. 2, 70-5(1951) Feb.

The International Commission on Radiological Protection (ICRP) draws attention to the data on maximum permissible exposures to radioisotopes for occupational workers presently used in the United States, Canada, and the United Kingdom. The isotopes considered are Ra^{226}, Pu^{239}, Sr^{89}, Sr^{90}, Po^{210}, T, C^{14}, Na^{24}, P^{32}, Co^{60}, and I^{131}.

1476

POSSIBILITY OF BIOLOGICAL EFFECTS OF COSMIC RAYS IN HIGH ALTITUDES, STRATOSPHERE AND SPACE. A. T. Krebs. J. Aviation Med. 21, 481-94(1950) Dec.

An abstract of this paper appeared in Tech. Data Dig. 16, No. 2, 43(1951) Feb. and is reproduced here in its entirety.

The biologic effects of cosmic radiation encountered in the stratosphere and in space travel and the possibility of such effects are discussed in detail. Using recent discoveries in cosmic-ray physics (heavy nuclei in the primary radiation, explosion stars at high altitudes, meson production, origin) and the report of Hess and Eugster on cosmic radiation and its biological effects, it is shown that at these altitudes biological effects of cosmic radiation have to be expected. By comparing the cosmic-ray events in high altitudes with data obtained in recent radium-poisoning investigations, a first rough estimation of the magnitude of cosmic-ray effects is made. For further investigations it is proposed to study: biological effects of star events—fission processes and meson processes; general biological effects and specific biological effects (genetic effects) on Drosophila, seeds, fungi, and protein solutions exposed, several times if necessary, at high altitudes; and correlation of these former two studies with the effects in deep mines.

1477

THE PROTECTION OF PERSONNEL ENGAGED IN ROENTGENOLOGY AND RADIOLOGY. F. T. Hunter and L. L. Robbins. New Engl. J. Med. 244, 9-13(1951) Jan.

Film-badge monitoring has led to lowered radiation exposure, and is therefore well worth the effort. Personnel become more cautious, and flaws in technique and protection are discovered. Radium workers may be subject to radiation "harder" than that of standards prepared from radium-platinum needles with no extra filtration. The personnel covered in this study are now receiving an average weekly exposure less than $\frac{1}{10}$ the so-called "permissible" exposure. (auth)

1478

PUBLIC HEALTH ASPECTS OF ATOMIC ENERGY. Abel Wolman. Am. J. Pub. Health 40, 1502-7(1950) Dec.

A review of nuclear-fission operations is presented which indicates potential areas in which the public health may be affected. These include peacetime effects, peacetime catastrophes, wartime problems, radiation genetics, and radiation in medical and other specialties. The attitude of official health departments is discussed.

1479

RADIATION HAZARDS IN THE ATOMIC ENERGY PROGRAM. Merril Eisenbud. Ind. Med. Surg. 20, 7-11 (1951) Jan.

A brief, general review of trends in knowledge of biological effects of radiation, permissible radiation levels, protection against radiation, methods of waste disposal, instrumentation, personnel monitoring, and industrial utilization of atomic energy is presented.

1480

RADIOACTIVE DI-IODO^{131}-FLUORESCEIN: THE HEALTH PHYSICS ASPECTS OF ITS USE FOR DIAGNOSTIC STUDIES. George V. LeRoy, Wilbur R. Tweedy, and Moses Ashkenazy. J. Lab. Clin. Med. 37, 122-8(1951) Jan.

Diiodo^{131}-fluorescein, in doses of 1000 to 1100 μc intravenously, can be used safely for diagnostic purposes. The total-body effective half-life is 4 to 7 days in man. There is no significant radiation hazard to the patient, or to the institution. There is a potential radiation hazard in the case of the attendants of incontinent patients, but in practice significant contamination has not been observed.

1481

RADIOLOGICAL PROTECTION—INTERNATIONAL COMMISSION RECOMMENDATIONS. Nucleonics 8, No. 1, 31-7 (1951) Jan.

Meeting in London in July 1950, the International Commission on Radiological Protection (ICRP) has adopted new radiation safety standards with more rigid criteria. These standards, released on January 1, 1951, contain many important recommendations, the majority of which are presented. Considerations included the following: exposure to external radiation, exposure to internal radiation, working conditions, general x-ray and radium recommendations, x-ray protective recommendations, film storage precautions, radium protective recommendations, and instruments.

1482

SUGGESTIONS FOR FIRST-AID TREATMENT OF CASUALTIES FROM ATOMIC BOMBING. Richard Warren and James H. Jackson. New Engl. J. Med. 243, 696-8(1950) Nov. 2.

Principles of casualty sorting are outlined, and first-aid treatment of burns, radiation injury, and radioactive contamination is discussed.

1483

WHAT EVERY MAINE DOCTOR SHOULD KNOW ABOUT THE MEDICAL ASPECTS OF ATOMIC WEAPONS AND ATOMIC WARFARE. Committee on Emergency Civilian Defense of the Maine Medical Association. J. Maine Med. Assoc. 41, 144-59(1950) May.

A general discussion is presented of the medical problems arising from an atomic bomb explosion. The types and distribution of injuries, radiation sickness, and radiological contamination are considered, and special attention is paid to the magnitude of the burn-treatment problem. The article is illustrated with photographs of Hiroshima and Nagasaki and with maps of Maine cities showing the damage distribution that would result from the explosion of atomic or hydrogen bombs.

RADIATION SICKNESS

1484

IRRADIATION SICKNESS. Wade S. Rizk. Mississippi Valley Med. J. 72, 184-5(1950) Nov.

The nature of radiation sickness is discussed, and a review of the various therapeutic drugs which have been advocated is presented. 21 references. (auth)

RADIOGRAPHY

1485

RADIOACTIVE MICROPHOTOGRAPHS FOR RESOLUTION TESTING IN AUTORADIOGRAPHY. G. W. W. Stevens. Brit. J. Radiology 23, 723-30(1950) Dec.

Radioactive resolution test charts were prepared by the chemical toning of the silver in minute photographic images. Conversion of the silver successively to AgBr and then to AgI could be effected with little loss of sharpness; the latter conversion was made with I^{131}. As the silver images are confined to the emulsion surface and have a known distribution of radioactive material, examination of autoradiographs prepared from them permits a systematic experimental examination to be made of the factors influencing the resolving power of this technique. Tests on the influence of the type of the autoradiographic emulsion and its coating thickness are described. The test charts can be supercoated with a gelatin layer of known thickness to indicate how resolution

is likely to suffer when the radioactivity is located below the surface of the histological specimen. Even a separation of 3 μ produced a serious reduction in sharpness, while one of 10 μ caused gross obliteration of fine detail. (auth)

1486

SOME NEW TRENDS IN AUTORADIOGRAPHY. Erik Odeblad. Nord. Med. 43, 1056-8(1950) June 30. (In Swedish)

Quantitative evaluations of an autoradiogram of a histological section cut from a P^{32}-containing tissue are made by measuring darkening intensities with the aid of a microphotoelectric device and a cathode-ray oscillograph.

RADIOTHERAPY

1487

DOSAGE NOMOGRAMS FOR SHORT LIFE RADIOACTIVE SUBSTANCES. R. G. Mitchell. Brit. J. Radiology 23, 740-2(1950) Dec.

The use of nomograms to facilitate the assessment of therapeutic dosage of short-lived radioisotopes is described. Nomograms for radon and I^{131} are shown. Provision is made for intermittent treatments and loss by excretion.

1488

RADIOIODINE (I^{131}) IN THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE THYROID. Fenton Schaffner, Morris T. Friedell, and Irvin F. Hummon. Illinois Med. J. 99, 15-21(1951) Jan.

Tracer studies of thyroid function using radioiodine were obtained in 58 patients using a simplified method of external survey. The average percentage uptake was 9.8% in patients with hypothyroidism, 22.6% in those with normal thyroid function, and 51.8% in those with hyperthyroidism. In general, an uptake of greater than 30% indicated hyperthyroidism. Radioiodine was given to 25 patients for the treatment of various diseases of the thyroid gland. Excellent results were obtained in the treatment of 18 out of 21 cases of toxic goiters. One case of hypothyroidism developed in this series. One case of nontoxic goiter responded well to treatment. None of the three cases of carcinoma of the thyroid treated showed any improvement. The use of radioiodine for diagnosis of the status of thyroid function is a simple procedure easily adapted for routine clinical use. The use of radioiodine may well become the treatment of choice for hyperthyroidism. 32 references. (auth)

1489

A 2-MEV X-RAY GENERATOR FOR THERAPY. H. Miller. Brit. J. Radiology 23, 731-9(1950) Dec.

A brief description is given of a 2-Mev electrostatic generator for x-ray therapy, with some details of its behavior during some months of routine clinical use. The servicing problems involved in the use of such an equipment are discussed. Physical measurements preliminary to clinical work are briefly described, details being given of the protection achieved around the set and of dose distributions in a water phantom. Experimental measurements on the variation of dose in the first few millimeters of the phantom, and the effect on this of changes of field size and focus skin distance are discussed. (auth)

TOXICOLOGY STUDIES

1490

THE DANGERS OF FLUORIDES. Frank P. Cleveland. Cincinnati J. Med. 31, 414-15(1950) Dec. (Note)

Symptoms of acute fluoride poisoning, mode of action of fluorides, and typical cases of sodium fluoride and sodium fluosilicate poisoning are reviewed briefly.

1491

INVESTIGATION OF THE TOXICITY OF RUTIN AND OF ITS INFLUENCE ON THE ACTION OF HISTAMINE. Helmut Hein and Heinz Laubmann. Arztl. Forsch. 4, I/666-70 (1950) Dec. 25. (In German)

The compatibility of rutin was tested on 13 rabbits and 25 white mice. Clinically, pathoanatomically, and histologically no injury could be detected in spite of high doses and continued application for up to 4 months. The influence of rutin on the action of histamine was examined. The histamine shock in the guinea pig, the appearance of a chemosis after an injection of a 2% histamine solution into the eye of the guinea pig, the formation of vesicles, and the Kokard reaction after intracutaneous injection of histamine in man could not be influenced significantly. Rutin could not influence the Sanarelli phenomenon in the rabbit. (auth)

1492

RETENTION OF INJECTED COLLOIDAL THORIUM DIOXIDE IN THE BODY OF THE LABORATORY MOUSE. Thomas W. Easton. Paper presented at the 47th Annual Meeting of the American Society of Zoologists, Cleveland, Ohio, Dec. 27-30, 1950.

An abstract of this paper appeared in Anat. Record 108, 515 (1950) Nov. and is reproduced here in its entirety.

Mice were injected intravenously through the tail vein with colloidal ThO_2 (Thorotrast), 0.2 cc/day on alternate days for three doses, a total of 0.6 cc. Success of injections was checked by roentgenogram, a heavy shadow at base of tail indicating poor injection. Such mice were not used. Thorotrast in the body was determined by ashing the entire mouse after dividing into various samples, and measuring the radioactivity with a Geiger counter. Thorotrast was determined in the whole body, in liver and spleen alone, and in the remainder of the body by comparing measured activity with that of measured amounts of the material injected. Values obtained were as follows: one day after last injection, mice retained from 0.4 to 0.59 cc of the original 0.6 cc. Of this the liver represented 25 to 55%; the spleen, 14 to 28%; and the remainder of the body, 17 to 51%. Ten days after last injection the total was 0.4 cc, with variations up to 0.1 cc. Of this, the liver held 55 to 70%; the spleen, 25 to 30%; and the remainder of the body, 5 to 20%. This level was maintained for 130 days, at least. Most of the variations observed in amount of Thorotrast retained appear to be due

to variations in liver content. Neither splenectomy nor fasting begun prior to injection appear to have any marked effect on retention or loss of ThO_2.

TRACER APPLICATIONS

1493

Argonne National Laboratory
RETENTION OF C^{14} ADMINISTERED AS BICARBONATE TO ADULT AND EMBRYONIC MICE. Austin M. Brues and Agnes N. Stroud. Nov. 1950. 19p. (AECU-1091; UAC-326)

Mice were exposed to $Na_2C^{14}O_3$ by injection, followed by a 10-hr period of rebreathing their expired air. Observations have been made on tissue C^{14} concentration to 10 months after exposure in adults and 20 months in mice exposed as embryos. Eventual loss rates in exposed embryos were parallel to those in exposed adults. The retention in various organs follows roughly a logarithmic function with concentration decreasing as the square root of time. This relationship holds, within a factor of 2, from 1 day to 10 months after exposure. It is possible that this curve may represent a series of exponential decay rates, and certainly no conclusions can be drawn as to the fate of C^{14} beyond the period of investigation. Bone carbonate C^{14} disappears somewhat more slowly than organic C^{14}. Consideration is given to the further data required to determine safe human exposure values to $C^{14}O_2$ and $Na_2C^{14}O_3$. It is obvious that present values are much more conservative than necessary. 12 references. (auth)

1494

Johns Hopkins University
FINAL REPORT ON RETENTION OF I^{131} BY BACTERIAL SLIMES IN DRAINS FOR NOVEMBER 15, 1949, TO NOVEMBER 15, 1950. Albert P. Talboys. Nov. 15, 1950. 39p. (JHUX-5)

A laboratory investigation of the uptake of I^{131} by heterogeneous bacterial slimes often present in waste-drain systems is reported. It is one of a series of studies undertaken by the Sanitary Engineering Department of The Johns Hopkins University to explore contamination of waste-line plumbing in institutions discharging radioisotope-bearing waste. Since I^{131}, as iodide, is not metabolized by the slimes, there is little tendency for concentration of the isotope by the slimes. However, the slimes retain small amounts of I^{131} by the processes of physical adsorption and adsorption of the active waste liquid. Resultant hazards to maintenance workers who may contact the contaminated slimes were computed from the experimental results and found to be of a very low level. (auth)

1495

University of Tennessee
QUARTERLY PROGRESS AND WORK ACCOMPLISHMENT REPORT FOR QUARTER ENDING JUNE 30, 1950; AGRICULTURAL RESEARCH PROGRAM. June 30, 1950. 17p. (ORO-7)

Brief technical reports are included on the progress and work accomplishment on the following projects: bomb radiation effects upon farm animals; fission product metabolism in animals; calcium metabolism in animals, (I) absorption and internal distribution; calcium metabolism in animals, (II) interrelationships with minerals, vitamins, hormones, and other factors; radiation effects on reproductive functions in farm animals—sperm physiology studies; radioisotopes in poultry nutrition studies; radioisotopes in the investigation of the physiology of milk secretion; behavior and fate of radioactive calcium after its incorporation in the soil; the relation of soil types to the availability of nutrients; and external radiation studies with large animals.

1496

Duke University
RENAL PHOSPHATE AND CARBOHYDRATE METABOLISM STUDIED WITH THE AID OF RADIOPHOSPHORUS. Philip Handler and Arthur F. Dratz. [nd.] 30p. (ORO-16)

The phosphate metabolism of the kidneys of normal fasted cats in situ has been investigated. A method has been devised for minimizing the biological variation among cats. The specific activities of intracellular inorganic phosphate and labile phosphate of ATP-ADP (adenosine triphosphate–adenosine diphosphate) reach a maximum and start to decrease in less than 5 min after the injection of P^{32}. The errors inherent in the procedures employed prevent the formulation of a rigorous conclusion regarding any precursor relationship between intracellular inorganic phosphate and the labile phosphate of ATP-ADP; however, the possibility exists that the terminal phosphate of adenosine triphosphate may be the precursor of intracellular inorganic phosphate. The bulk of the activity of glucose-1-phosphate was not derived from glucose-6-phosphate. The activity of glucose-1-phosphate may have been derived either from inorganic phosphate by means of the phosphorylase reaction, indicating that a dynamic equilibrium existed between glucose-1-phosphate and glycogen, or from ATP by direct phosphorylation of glucose in the 1-position. The activity of glucose-6-phosphate could readily be accounted for as coming from glucose-1-phosphate by the phosphoglucomutase reaction, or from ATP by the hexokinase reaction. However, the turnover of glucose-6-phosphate appeared to be so slow that the hexokinase reaction cannot serve as an obligatory process in the tubular reabsorption of glucose. (auth)

1497

RADIOACTIVE ISOTOPES. Gerard A. Leifchild. X-Ray Technician 22, 209-12(1951) Jan.

More than 700 radioactive isotopes are now known. About 250 of these have suitable half-lives and emit useful radiation for biologic and medical work. Questions such as what is an isotope and how is it made are discussed, and a brief sketch as to how isotopes are used in medical diagnosis and therapy is given.

1498

RADIOISOTOPES IN PHARMACEUTICAL AND MEDICAL STUDIES. III. D. L. Tabern, J. D. Taylor, and G. I. Gleason. Nucleonics 8, No. 1, 60-77(1951) Jan.

Studies to determine the chemical changes in living cells after administration of certain tagged drugs, amino acids, vitamins, etc., are outlined in an extensive discussion of drug metabolism. General conclusions to be drawn from this and the preceding articles in this series are also presented. 156 references. (auth)

CHEMISTRY

1499

Metal Hydrides, Inc.
INFORMAL PROGRESS REPORT NO. 21 (SHORT REPORT NO. 6); CONTRACT SC-2026 TO NEPA DIVISION. Thomas R. P. Gibb, Jr. May 18, 1950. 6p. (NEPA-1419)

Summaries of studies on the chemistry, production and composition of uranium and titanium hydrides, tungsten-boron hydrides, aluminum hydride, and lithium borohydride are presented.

1500

DIPHENYLGERMANE AND DIHALODIPHENYLGERMANE. Otto H. Johnson and Darrel M. Harris. J. Am. Chem. Soc. 72, 5564-6(1950) Dec.

The two new compounds, diphenylgermane and diiododiphenylgermane, have been prepared, and some properties are described. Reduction of mixed bromophenylgermanes with lithium aluminum hydride gave the corresponding phenylgermanes readily separated by fractionation. Dibromodiphenylgermane is easily prepared by the bromination of diphenylgermane. Diiododiphenylgermane is formed by bromination of diphenylgermane at relatively low temperatures followed by the replacement of the bromine by iodine from hydriodic acid. Attempts to iodinate diphenylgermane directly yielded principally germanium tetraiodide. A convenient method of preparing hexaphenyldigermane is described. (auth)

1501

M.I.T. Laboratory for Nuclear Science and Engineering
NUCLEAR CHEMISTRY (INORGANIC) GROUP, p.51-84 of [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950.] C. D. Coryell and J. W. Irvine, Jr. July 1, 1950. 34p. (NP-1777(p.51-84))

Solvent-extraction studies of the ferric halide–acid-ether systems and Mn(II)-Cr(III)-V(IV) in KSCN-ketone systems, and investigations of the chloro complexes of Te(IV) and of the ionization constant of HNO_3 have been completed and are reported in some detail. Progress in studies of counting methods, phosphors for scintillation counters, ion-exchange equilibria, rapid rare-earth separations, Ag(II) complexes, distribution of nuclear charge in fission, decay and fission yields of Te and I activities, and identification of As and Nd activities in fission is summarized.

1502

REACTION OF GERMANES. I. WITH ALKALI METALS AND AMIDES. II. POLYALKYLGERMANES. III. PHENYL BROMIDE AND SODIUM GERMANYL. Sivert N. Glarum and Charles A. Kraus. J. Am. Chem. Soc. 72, 5398-401 (1950) Dec.

Ethyl-, methyl-, and isoamylgermane react with sodium in liquid ammonia to yield germanyl salts. The reactions are not quantitative; more than one equivalent of germane is required to complete reaction with a given quantity of metal, and more than an equivalent amount of hydrogen is evolved. With lithium in ethylamine, the reactions of monalkylgermanes are more nearly quantitative but even here considerable side reaction occurs. With lithium and ethylgermane in ethylamine, a considerable amount of ethane is evolved; some, if not all, of this appears to come from the amine. Ethylisoamylgermane reacts substantially quantitatively with lithium in ethylamine. Potassium amide reacts with germane in liquid ammonia to form potassium germanyl in considerable amount. The reaction is not quantitative and approximately one atom of hydrogen is evolved per mole of amide. Ethylisoamyl- and diethylisoamylgermane were prepared by reaction of appropriate alkyl halides with lithium germanyls in ethylamine. Phenyl bromide reacts with sodium germanyl according to the equation $C_6H_5Br + NaGeH_3 = C_6H_6 + GeH_2 + NaBr$. The digermane, GeH_2, is soluble in liquid ammonia from which it may be crystallized as a white solid. It decomposes slowly at −33°C and rapidly at higher temperatures to form GeH_4 and GeH. One mole of GeH_2 reacts with one atom of sodium to form a soluble salt. On addition of ammonium bromide, GeH_4 is evolved. (auth)

1503

SOME REACTIONS OF TRIPHENYLGERMANE. Otto H. Johnson and Darrel M. Harris. J. Am. Chem. Soc. 72, 5566-8(1950) Dec.

When dilute triphenylgermane solution is added to phenyllithium solution, the principal product is tetraphenylgermane with a very small fraction of hexaphenyldigermane being formed. When the triphenylgermane is present in large excess, over half of the resulting product is hexaphenyldigermane with the tetraphenyl compound present in lesser quantity. The possibility is advanced that triphenylgermyllithium is present in the solution. Triphenylgermane gives iodotriphenylgermane with iodine and chlorotriphenylgermane with benzoyl chloride. At higher temperatures triphenylgermane was found to disproportionate rapidly, yielding tetraphenylgermane, triphenylgermane, and diphenylgermane. (auth)

1504

THE TITANIUM-HYDROGEN SYSTEM AND TITANIUM HYDRIDE. I. LOW-PRESSURE STUDIES. Thomas R. P. Gibb, Jr., and Henry W. Kruschwitz, Jr. J. Am. Chem. Soc. 72, 5365-9(1950) Dec.

Stoichiometric titanium hydride was prepared and its density determined. The dissociation pressure was measured for the Ti-H system over the range 500 to 800°C, 50 to 800 mm, and a hysteresis was noted in the 600°C isotherm. X-ray diffraction patterns were observed for several compositions in the range $TiH_{0.88}$ to TiH_2 and two evanescent lines were found in the pattern of the stoichiometric hydride. A nearly linear relation of density to composition was found in this system from Ti to TiH_2. Titanium containing small quantities of interstitial hydrogen was found to react rapidly with pure hydrogen at room temperature and atmospheric pressure. (auth)

ANALYTICAL PROCEDURES

1505

University of California Radiation Laboratory
RECOVERY AND ESTIMATION OF RADIOISOTOPES FROM BIOLOGIC MATERIALS; II. THE ELECTROPLATING APPARATUS; PROCEDURES FOR COPPER, SILVER, ZINC, MERCURY, IRON AND COBALT. Rayburn W. Dunn. Sept. 27, 1950. 17p. (UCRL-932)

A relatively inexpensive apparatus for the simultaneous electroplating of up to 12 samples is described. Various kinds of cathodes are listed, with their special applications and methods of preparation for use. A general discussion of the nature of solutions of ashed biologic material is included, with a discussion of the use of carriers. A brief outline is presented of procedures for use with copper, silver, zinc, mercury, iron, and cobalt. (auth)

1506

M.I.T. Laboratory for Nuclear Science and Engineering
CHEMISTRY OF THE FISSION ELEMENTS GROUP, p.3-10 of [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950.] D. N. Hume and L. B. Rogers. July 1, 1950. 8p. (NP-1777(p.3-10))

The status of the following investigations is summarized: analytical chemistry of Nb, Ce, and Zr; thiocyanate complexes of the fission elements; photometric titrations; fundamental principles of polarography; quantitative microanalytical procedures for Ag; electroseparation of carrier-free Ag and Mn tracers; separation of carrier-free Mn^{52} by distillation; adsorption errors in microanalysis; and conductometric, dielectric, fluorimetric, and flame photometric methods of analysis.

1507

DETERMINATION OF SMALL AMOUNTS OF CHROMIUM AND VANADIUM BY AMPEROMETRIC TITRATION. Thomas D. Parks and Eligio J. Agazzi. Anal. Chem. 22, 1179-81(1950) Sept.

An amperometric method for the rapid determination of Cr and V is described. Cr and V are oxidized to chromate ion and vanadate ion by heating with perchloric acid and treatment with permanganate. Chromate and vanadate ions are titrated amperometrically with ferrous solution at the rotating platinum electrode. Reduced V is selectively reoxidized to vanadate ion with permanganate ion and again titrated amperometrically. Cr is obtained by difference. The method has been successfully applied to steel, crude oil, oil residuum, and asphalt samples. As little as 5 μg of Cr or V can be determined. (auth)

1508

FLUOROMETRIC MICRODETERMINATION OF URANIUM. I. FLUORESCENT MATERIAL FOR THE DETERMINATION. Masaki Nakanishi. Bull. Chem. Soc. Japan 23, 61-4(1950) July.

The fluorescence method is recommended as the most sensitive method for the determination of U. Fluorescent material consisting of NaF containing a small amount of U (10^{-4} to 10^{-9} g/20 mg of NaF) was investigated from several sides. The relation between fluorescence intensity and U content is described, and the spectral energy distribution of the fluorescence band spectrum was studied by spectrophotometry. Various interfering factors in this method were examined, especially as to its analytical application. (auth)

1509

MASS SPECTROMETRIC ANALYSIS OF LOW-MOLECULAR-WEIGHT MONODEUTERO-PARAFFINS. D. P. Stevenson and C. D. Wagner. J. Am. Chem. Soc. 72, 5612-17(1950) Dec.

Generally applicable methods for the determination of C_nH_{2n} and C_nH_{2n-2} impurities in preparations of $C_nH_{2n-1}D$ are described. The methods, based on the properties of the initial portions of the ionization efficiency curves of ions in mass spectra, permit the detection of 0.01 to 0.05% C_nH_{2n} and 0.5 to 1.0% C_nH_{2n-2} in $C_nH_{2n-1}D$ for $n \geq 3$ even in the absence of authentic samples of $C_nH_{2n-1}D$ for comparison purposes. The mass spectrometric data necessary for performing such analyses of monodeutero-methane, -ethane, -propane, and -butane preparations are given in figures. (auth)

1510

METHOD OF DETERMINATION OF BORON IN PYREX BASED ON TRANSPARENCY TO THERMAL NEUTRONS. Jean Govaerts. Experientia 6, 459-61(1950) Dec. 15. (Brief report; in French)

Boron is the only element in pyrex glass with a high neutron-absorption cross section. Using dysprosium detectors, a standard curve can be obtained indicating the activity measured for different concentrations of boron in the powdered pyrex. Working always under the same geometrical conditions, unknown concentrations of boron in pyrex can be easily determined.

1511

ON THE PRECIPITATION AND DETERMINATION OF BERYLLIUM IN THE OXIDE STATE. Thérèse Dupuis. Mikrochemie ver. Mikrochim. Acta 35, 477-87(1950) Oct. (In French)

The author has traced with the aid of a Chevenard thermobalance the pyrolysis curve, up to about 1000°C, of different compounds obtained with the intention of determining

Be by weighing its oxide. An accompanying table gives the minimum temperatures at which this oxide is obtained in practice. Certain methods of precipitation are new; thus the precipitate produced by means of ammonia gas filters easily, but the study of its spectrum by Debye and Scherrer does not indicate that it may, because of that, crystallize in the α-hydroxide form. 19 references. (auth)

1512

PHTHALIC ACID AS A SELECTIVE REAGENT FOR ZIRCONIUM. A. Purushottam and B. S. V. Raghava Rao. Analyst 75, 684-5(1950) Dec.

Phthalic acid precipitates Zr quantitatively from solutions 0.35N with respect to free HCl. From solutions 0.3N in HCl, most elements, such as Th, Fe, Al, Be, U, Mn, Ni, and ceria earths, can be separated in a single precipitation, but Sn, Ti, V, and Cr require a second precipitation. The reagent is thus selective for Zr. (auth)

1513

SEPARATION OF A SMALL AMOUNT OF TITANIUM FROM IRON BY ION-EXCHANGE RESIN. Yukichi Yoshino and Masuo Kojima. Bull. Chem. Soc. Japan 23, 46-7(1950) July.

Separation of a small amount of Ti from Fe with cation exchange resin was studied with alkali cyanide solution as the eluting agent for iron. Successful results were obtained even in the case of high (100-to-1) Fe concentration. This method permits removal of the interfering effect of the Fe on Ti colorimetry with H_2O_2. As an example of practical application, this method was tried in determining the Ti content of a limonite. The result agreed with that of the ordinary H_2S method of separation. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

1514

SILICON CARBIDE OF 594 LAYERS. Goro Honjo, Shizuo Miyake, and Takanori Tomita. Acta Cryst. 3, 396-7(1950) Sept. (Short communication)

In the course of x-ray study on single crystals of SiC a sample which was found recently contains partly a new modification having an extraordinarily long period, the other part being composed of the structure with 6-layer period (SiC(6)). An oscillation photograph taken through 5 deg around the c axis to record specifically the $(10\bar{1}1)$ rod for which $h + 2k = 1$ is shown. The reciprocal-lattice points of the new modification are distributed on the $(10\bar{1}1)$ rod with an interval $\frac{1}{33}$ of that for SiC(6), indicating a lattice period along the c axis corresponding to at least $6 \times 33 = 198$ layers. Laue patterns were taken on cylindrical films ($R = 8$ cm) with the incident x-ray beam nearly parallel to the c axis and perpendicular to the $[11\bar{2}0]$ and $[1\bar{1}00]$ axes, respectively, the latter axes being set parallel to the axis of the cylindrical films. The Laue photographs reveal that none of the reciprocal points of the new modification coincides with those of SiC(6) which have hexagonal symmetry. The reciprocal points of the latter structure are situated at a position one-third the way between the nearest two reciprocal-lattice points of the new modification. The ultimate c period of the new modification, therefore, does not correspond to 198 layers, but the triple of it, $3 \times 6 \times 33 = 594$ layers. The lattice period along the hexagonal c axis of the new modification is $2.51 \times 594 \approx 1500$ A. The range of the ordering force for layers in this structure, therefore, should be at least $2.51 \times 594 \div 3 \approx 500$ A, which cannot be understood in terms of the conventional type of force between layers.

FLUORINE AND FLUORINE COMPOUNDS

1515

THE NEAR ULTRAVIOLET ABSORPTION SPECTRA OF SOME FLUORINATED DERIVATIVES OF METHANE AND ETHYLENE. J. R. Lacher, L. E. Hummel, E. F. Bohmfalk, and J. D. Park. J. Am. Chem. Soc. 72, 5486-9(1950) Dec.

By the use of carefully purified vapor samples, the long-wavelength ultraviolet absorption spectra of the following compounds have been measured: CCl_4, $CFCl_3$, $CHCl_3$, CF_2Cl_2, $CHFCl_2$, CH_2Cl_2, $CCl_2=CCl_2$, $CFCl=CCl_2$, $CHCl=CCl_2$, $CFCl=CFCl$ (cis-trans), $CF_2=CCl_2$, $CH_2=CCl_2$, $CHCl=CHCl$ (trans), $CHCl=CHCl$ (cis), $CF_2=CFCl$, $CF_2=CF_2$ and $CH_2=CHCl$. The spectra appear to be continuous and obey Beer's law. Whenever a H atom is replaced by F in a halomethane, the absorption shifts to shorter wavelengths because of the inductive effect of the F. In an ethylenic compound, however, the absorption shifts to longer wavelengths when H is replaced by F. This is interpreted to mean that F undergoes resonance with the double bond and that this mesomeric effect outweighs the inductive effect. (auth)

1516

THERMODYNAMIC FUNCTIONS FOR FLUORINE. George M. Murphy and John E. Vance. J. Chem. Phys. 18, 1514-15(1950) Nov. (Letter to the editor)

The entropy, free energy, and heat capacity of fluorine gas from 298.16 to 2000°K have been recalculated using the most recently determined molecular constants and the revised values of natural constants. The resulting values are smaller in every case than the previously determined values (Murphy and Vance, J. Chem. Phys. 7, 806(1939)).

1517

2,4,6-TRIS-(TRIFLUOROMETHYL)-STYRENE. Earl T. McBee and Robert A. Sanford. J. Am. Chem. Soc. 72, 5574-5(1950) Dec.

The synthesis and the attempted polymerization of 2,4,6-tris-(trifluoromethyl)-styrene are described. An attempt to prepare 2,4,6-tris-(trifluoromethyl)-α-methylstyrene was unsuccessful. (auth)

LABORATORIES AND EQUIPMENT

1518

Oak Ridge National Laboratory
SERVICE (ABRASION) TESTING OF SELECTED PROTECTIVE COATINGS. C. D. Watson and G. A. West. Dec. 11, 1950. 12p. (ORNL-868)

Thirteen paints and three strippable coatings which were outstanding in corrosion-resistance and decontamination studies have been subjected to service wear tests to further define their usefulness. The relative resistance to heavy foot and light vehicle traffic is presented, and certain coatings are recommended for use in radiochemical facilities.

1519

DESIGN AND PERFORMANCE OF A JOULE-KELVIN HELIUM LIQUEFIER. J. G. Dash, D. B. Cook, M. W. Zemansky, and H. A. Boorse. Rev. Sci. Instruments 21, 936-8(1950) Nov. (Laboratory and shop note)

A helium liquefier having a capacity of 1 liter/hr and using the Joule-Kelvin principle for liquefaction is described. The design procedure, which was found to yield results in good agreement with calculation and which may be applied to the construction of almost any liquefaction system, is outlined.

RADIATION CHEMISTRY

1520

SOME ASPECTS OF THE BEHAVIOR OF CARRIER-FREE TRACERS. I. Norman A. Bonner and Milton Kahn. Nucleonics 8, No. 2, 46-59, 75(1951) Feb.

The key to carrier-free-tracer chemistry is the high sensitivity of energetic-radiations detection equipment that makes it possible to estimate extremely small amounts of radioelements. Various methods of coprecipitation, important in this branch of "hot-atom" chemistry, are discussed. 28 references. (auth)

RADIATION EFFECTS

1521

CHEMICAL ACTION OF IONIZING RADIATIONS ON NUCLEIC ACIDS IN AQUEOUS SYSTEMS. George Scholes and Joseph Weiss. Nature 166, 640-2(1950) Oct. 14.

Previous experiments on detection and isolation of products formed in x-irradiated solutions of nucleic acids have employed fairly high doses (10^6 r). Studies have now been carried out on 0.05% aqueous solutions of yeast sodium ribonucleate and the sodium salt of thymus desoxyribonucleic acid irradiated with 30,000 to 150,000 r of 200-kv x rays. Even at the lowest dose, ammonia and inorganic phosphate could be determined. Irradiations were performed in air, vacuum, and hydrogen. Reasons for the variation in ammonia and phosphate production under these conditions are discussed. It is concluded that even with doses approaching those of biological significance, the degradation of nucleic acids by x rays is of a chemical nature, and that both hydroxyl and hydrogen-ion-free radicals are effective under suitable conditions.

1522

CHEMICAL DOSIMETRY OF IONIZING RADIATIONS. M. J. Day and Gabriel Stein. Nucleonics 8, No. 2, 34-45 (1951) Feb.

Chemical techniques were among the first used to measure radiation dose. Lately, after being long overshadowed by ionization techniques, they have found new importance. Local, integral, and autointegral dose can be measured accurately with liquids and gels by employing the methods described. 45 references. (auth)

1523

IONIZING RADIATION AS A TEST OF MOLECULAR ORGANIZATION. Ernest Pollard. Am. Scientist 39, 99-109(1951) Jan.

The nature of the effect in a large molecule of energy release due to ionizing radiation has been studied. Results show that where precise molecular organization is necessary for the action of a molecule, such as, for example, in the action of an enzyme on a substrate, the enzyme organization is destroyed over a large region by the action of primary ionization. Rough figures for molecular weights can be obtained by these methods, and some conclusions about enzyme structure can be drawn. The present study includes the results of many investigators.

1524

MASS-SPECTROMETRIC STUDY OF DECOMPOSITION OF GERMANE (GeH_4) BY ELECTRON BOMBARDMENT. M. Nève de Mévergnies and J. M. Delfosse. Ann. soc. sci. Bruxelles 64, Sér. I, 188-95(1950) Dec. 13. (In French)

Using a Dempster pyrex spectrometer, a gas analysis of ions formed from GeH_4 by electron bombardment was made, together with the determination of their appearance potentials. It was observed that, besides the generation of ions, a formation of free radicals took place as a result of a thermal dissociation. The results permitted an estimate of the mean energy of the bond Ge−H. (auth)

1525

RADIOCHEMICAL EQUILIBRIA IN IRRADIATED WATER. P. Bonet-Maury and M. Lefort. Nature 166, 981-2(1950) Dec. 9.

By irradiating water acidified with H_2SO_4 or HCl and pure water saturated with oxygen, as well as alkaline and oxygen-free solutions, before adding the titanium sulfate H_2O_2-complex-forming reagent, an amount of H_2O_2 is determined which corresponds to an equilibrium between the rate of formation and rate of decomposition under these conditions characteristic of the radiation used. The radiochemical yield and considerations as to the reaction mechanism initiated by different radiations may be derived from the

equilibrium values. The radiochemical yield is practically constant for α rays under all conditions, whereas the yield for x rays increases with temperature, intensity, and concentration of dissolved oxygen, and decreases with radiation dose and pH. Two separate mechanisms are considered for H_2O_2 formation by x and α radiation.

RARE EARTHS AND RARE-EARTH COMPOUNDS

1526

ABSORPTION AND EMISSION SPECTRA OF PROMETHIUM. William F. Meggers, Bourdon F. Scribner, and William R. Bozman. J. Research Natl. Bur. Standards 46, 85-98(1951) Feb.

The absorption spectrum of a 5-mg sample of fission-product Pm^{147} in solution was plotted between 3500 and 10,000 A: the principal bands have wavelengths 494.5, 548.5, 568.0, 685.5, 735.5 mμ (±0.5 mμ). Small portions of the sample were dried on Cu electrodes employed in photographing a-c arc and spark spectra with a concave grating of 22-ft radius. Excepting Sm, into which Pm decays, no other rare earths could be detected in this sample, but common chemical contaminants were troublesome. Between 2200 and 6900 A the wavelengths and relative intensities of more than 2200 new spectral lines were determined, but it was not possible to differentiate Pm I and Pm II lines with the light sources employed. The strongest Pm lines have wavelengths 3892.16, 3910.26, 3919.09, 3957.74, and 3998.96 ± 0.02 A. Hyperfine structure is suspected in some Pm lines, indicating that the nuclei of Pm^{147} atoms possess mechanical and magnetic moments. Confirming the findings of the Oak Ridge National Laboratory, both the absorption and the emission spectrum identify this fission product as a new element of rare-earth type, and provide positive proof that the element with atomic number 61 has been discovered.

1527

OBSERVATIONS ON THE RARE EARTHS. LVIII. REACTION BETWEEN NEODYMIUM AND ETHYLENEDIAMINETETRAACETATE IONS IN AQUEOUS SOLUTION. Therald Moeller and J. Calvin Brantley. J. Am. Chem. Soc. 72, 5447-51(1950) Dec.

The absorption spectra of neodymium chloride solutions containing varying quantities of added ethylenediaminetetraacetate have been measured over the wavelength range 2500 to 10,000 A. In the range 5100 to 10,000 A every neodymium absorption band is split into two or more bands. The most pronounced effects occur in the range 5100 to 6000 A where the 5218-A band is split into four definite bands with two additional inflections and the 5750-A band is split into five definite bands with two additional inflections. These effects are interpreted as indicating interactions between neodymium and ethylenediaminetetraacetate ions in solution. Spectrophotometric measurements at 2500 to 2600 A suggest the presence of at least a 1:1 complex, but cannot be regarded as conclusive. Electrometric titration studies indicate clearly the presence of a 1:1 complex. No evidence for any other species has been obtained. Electrophoretic migration studies show the neodymium complex to be anionic in character. The complex is stable in alkaline solutions. (auth)

1528

THE RARE EARTHS OR "LANTHANONS." A. W. Wylie. Roy. Australian Chem. Inst. J. Proc. 17, 377-97(1950) Oct.

A general outline of the chemistry of the rare earths, their electronic structure, the compounds they form with other elements, and the methods of their separation is presented. 47 references.

SEPARATION PROCEDURES

1529

University of California Radiation Laboratory
THE SEPARATION OF MIXTURES OF MONO AND DI SUBSTITUTED ALKYL PHOSPHORIC ACIDS. H. W. Crandall and D. C. Stewart. Sept. 6, 1950. 3p. (UCRL-904)

A number of alkyl phosphoric acids are available commercially, but only as mixtures of the mono-(H_2RPO_4) and di-(HR_2PO_4) substituted forms. If one or the other of these acids is desired in a separated state, separation may be readily accomplished by taking advantage of the differences in the distribution of the two forms between two immiscible phases, generally water and some organic solvent. Using this technique, completely separated solutions of diethyl phosphoric acid in n-amyl alcohol, dipropyl phosphoric acid in isopropyl and dibutyl ethers, dibutyl phosphoric acid in n-amyl alcohol and in dibutyl ether, diisobutyl phosphoric acid in dibutyl ether, diamyl phosphoric acid in dibutyl ether, dioctyl phosphoric acid in dibutyl ether (from diethylene glycol rather than water), and monobutyl phosphoric acid in water have been prepared.

1530

ADSORPTION OF IRON BY ANION EXCHANGE RESINS FROM HYDROCHLORIC ACID SOLUTIONS. George E. Moore and Kurt A. Kraus. J. Am. Chem. Soc. 72, 5792-3 (1950) Dec. (Communication to the editor)

As part of a more general study of the anion exchange behavior of metal ions in chloride and fluoride solutions it was found that iron(III) can be strongly adsorbed from relatively concentrated hydrochloric acid solutions. The results of a series of elution experiments with tracer Fe^{59} and 0.023-cm^2 columns of Dowex-1 are shown. The strong adsorbability of iron is probably due to the formation of negatively charged complexes such as $FeCl_4^-$. This offers an effective separation method for iron from aluminum, chromium, rare earths, and possibly other ions of oxidation number three.

SORPTION PHENOMENA

1531

ADSORPTION OF BENZENE AND CYCLOHEXANE BY GRAPHITE. R. Nelson Smith, Conway Pierce, and Herman Cordes. J. Am. Chem. Soc. 72, 5595-7(1950) Dec.

Isotherms are given for benzene and cyclohexane on Graphon, a partially graphitized carbon black, at tempera-

tures of 5.5 and 28.6°C. The area covered per molecule is found to be ~38 A^2 for cyclohexane and 41 A^2 for benzene. Both indicate that the molecules lie flat on the surface. The isotherms and isosteric heats of adsorption computed from them show that in the first layer cyclohexane is more strongly held than benzene. In the multilayer region benzene is the more strongly adsorbed. Areas per molecule are given for a variety of adsorbates, as obtained from isotherms on Graphon and carbon blacks. These are compared with areas computed from models. (auth)

1532

National Research Council of Canada
THE KINETICS OF DESORPTION OF ACTIVATED ADSORBED HYDROGEN; trans. from Zhur. Fiz. Khim. 23, 897, 1949. N. P. Keier and S. Z. Roginskii; trans. by Esther Rabkin. Aug. 1950. 50p. (TT-124)

The following subjects are discussed: desorption isotherms of hydrogen on carbon, desorption kinetics, temperature relations, the relation between desorption rate and surface coverage, the effect of initial preheating, and a differential isotopic method for investigating heterogeneity of activated carbon.

SPECTROSCOPY

1533

ISOTOPE SHIFTS IN ENHANCED SAMARIUM ISOTOPES. D. D. Smith and J. R. McNally, Jr. J. Optical Soc. Am. 40, 878(1950) Dec. (Letter to the editor)

The spectra of enhanced samples of Sm^{144} (72.13% isotopic vs. 3.14% natural abundance) and of Sm^{154} (92.10% vs. 22.53%) in the wavelength region 2200 to 8450 A at dispersions of 1.2 to 0.4 A/mm have been photographed. More than 400 shifts have been observed, with the Sm^{154} lines to the violet of the Sm^{144} lines in the majority of cases. Large isotope spectrum displacements at 5100 A are illustrated. No appreciable shift is observed in the line at 5117.2 A.

SYNTHESES

1534

MICRO SYNTHESES WITH TRACER ELEMENTS. III. THE SYNTHESIS OF THIOUREA LABELED WITH C^{14} AND OF THIOUREA LABELED WITH S^{35}. C. Wayne Bills and Anthony R. Ronzio. J. Am. Chem. Soc. 72, 5510-11(1950) Dec. (See also NSA 4-420 and 4-1403)

A method of labeling thiourea with C^{14}, a method for the quantitative formation of hydrogen sulfide-S^{35} from cadmium sulfide-S^{35}, and a method of labeling thiourea with S^{35} have been described. The S^{35}-thiourea possessed an activity of 0.535 mc/mg.

1535

PREPARATION OF 6,7-d_2-ESTRONE ACETATE. W. H. Pearlman and M. R. J. Pearlman. J. Am. Chem. Soc. 72, 5781(1950) Dec. (Note)

The preparation of this deuterium-labeled estrogen from Δ^8-dehydroestrone in practically quantitative yield is described.

1536

THE PREPARATION AND PURIFICATION OF METHANE-d, ETHANE-d, PROPANE-1-d, PROPANE-2-d, n-BUTANE-1-d, n-BUTANE-2-d, ISOBUTANE-1-d AND ISOBUTANE-2-d. C. D. Wagner and D. P. Stevenson. J. Am. Chem. Soc. 72, 5785(1950) Dec. (Note)

The preparation of these labeled hydrocarbons by Grignard reactions with deuterium oxide or deutero acids according to previously described procedures has been carried out, and the chemical, isomeric, and isotopic purities of the products have been determined. Special attention is paid to the olefin and alkane impurities.

1537

THE SYNTHESIS OF CARBON-ISOTOPIC ALKANES: METHANE-C^{13}, PROPANE-1-C^{13}, n-BUTANE-1-C^{13}, n-BUTANE-1-C^{14}, ISOBUTANE-1-C^{13}, ISOBUTANE-1-C^{14}, AND ISOBUTANE-2-C^{13}. C. D. Wagner, D. P. Stevenson, and J. W. Otvos. J. Am. Chem. Soc. 72, 5786(1950) Dec. (Note)

The preparation by various reactions, on a 5- to 20-millimole scale, of these labeled compounds is described briefly. The isotopic compositions and mass-spectrographically determined purity are tabulated.

TRACER APPLICATIONS

1538

Oregon State College
ACID-BASE EXCHANGE REACTIONS IN LIQUID SULFUR DIOXIDE. Rowland E. Johnson, T. H. Norris, and J. L. Huston. [nd.] 20p. (AECU-1108)

The tracer, S^{35}, has been used to study the rate of exchange between the solvent, liquid sulfur dioxide, and three solutes, namely the "base," tetramethylammonium pyrosulfite, and the two "acids," thionyl chloride and thionyl bromide. The pyrosulfite is found to exchange almost completely within 20 min even at ~−75°C. Thionyl bromide exchanges extremely slowly, with a half-time at 25°C of about 1.9 yr. The maximum exchange rate of thionyl chloride appears to be even lower at this temperature and at best not much greater at 61°C. For the case where sulfur dioxide is dissolved in a large excess of thionyl chloride, an even lower maximum rate is observed. These results indicate that while a "base" yields sulfite ions in the solvent sulfur dioxide, "acids" (i.e., thionyl compounds) yield a negligible amount of thionyl ion. (auth)

1539

M.I.T. Laboratory for Nuclear Science and Engineering
NUCLEAR CHEMISTRY (ORGANIC) GROUP, p.85-90 of [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950.] J. D. Roberts. July 1, 1950. 6p. (NP-1777(p.85-90))

Tracer studies on carbonium ion rearrangements, decarboxylation of diphenyl triketone, and orientation in aromatic substitution are summarized, with a brief report on the hydrogen-isotope effect on acid-catalyzed reactions.

1540

RADIOACTIVE INDICATORS IN THE INVESTIGATION OF REACTIONS BETWEEN POWDERS. Roland Lindner. Z. Elektrochem. 54, 430-3(1950) Oct. (In German)

The dynamics and other aspects of chemical reactions between powdered solids are being studied with the aid of β-radioactive indicators at the Silicates Institute, Göteborg, Sweden. The preliminary experiments made so far have been concerned with the diffusion of thin surface films of tagged metal into compressed tablets of powdered oxides or salts of the same metal.

TRITIUM AND TRITIUM COMPOUNDS

1541

Ohio State University Cryogenic Laboratory
CRITICAL CONSTANTS, BOILING POINTS, TRIPLE POINT CONSTANTS AND VAPOR PRESSURES OF THE SIX ISOTOPIC HYDROGEN MOLECULES, BASED ON A SIMPLE MASS RELATIONSHIP. (TECHNICAL REPORT NO. 11). Abraham Solomon Friedman, David White, and Herrick L. Johnston. Nov. 9, 1950. 17p. (NP-1853)

Constants of simple equations for properties of the isotopic hydrogen molecules, H_2, HD, D_2, HT, DT, and T_2, have been estimated, and calculated values of the properties have been compared with experimental data when known. 3 tables. 3 figures.

URANIUM AND URANIUM COMPOUNDS

1542

Imperial Chemical Industries, Ltd.
PREPARATION OF 25 KILOGRAMS OF ACID-FREE ANHYDROUS URANYL SULFATE. G. McConnell. June 18, 1943. 4p. (BR-229A; R/GC/1336)

The preparation of anhydrous of uranyl sulfate free from excess sulfuric and nitric acid is described. An aqueous solution of uranyl sulfate containing about 30% excess sulfuric acid and traces of nitric acid was obtained by dissolving the oxide U_3O_8 in a mixture of these two acids, and the excess acids were removed by repeated precipitation of the acetone complex $UO_2SO_4 \cdot 2H_2O(CH_3)_2CO$ (formed when acetone is added in equal volume to the aqueous solution of sp gr 1.65 to 2.00) with subsequent stripping of the acetone by boiling with water. It was found that a minimum of three precipitations were required for removal of the free acid. The purified liquors were then concentrated to a specific gravity greater than 2.24 in silica balloons and allowed to crystallize overnight. In this way the trihydrate, $UO_2SO_4 \cdot 3H_2O$, was obtained, which was filtered, dried at 95°C, powdered, and dehydrated in vacuo (25 mm Hg) at 190 to 200°C. The final dehydration was carried out in silica dishes, and the preliminary drying at 95°C was found necessary in order to avoid breakages of the silica ware, due to incipient fusion of the mass followed by resolidification accompanied by expansion. (auth)

1543

Imperial Chemical Industries, Ltd.
THE PREPARATION OF SMALL QUANTITIES (APPROXIMATELY 1 g) OF PURE UF_6. H. A. Skinner. May 8, 1944. Decl. July 22, 1949. 6p. (BR-423A; BDDA-212; R/GG/1603)

A method is described for the preparation of small quantities, of the order of a gram, of UF_6, by direct fluorination of UF_4. The method gives a yield corresponding to an efficiency of conversion of 80 to 95%. (auth)

1544

Imperial Chemical Industries, Ltd.
URANYL FLUORIDE: MISCELLANEOUS NOTES: NOTE NO. 38; THE DRYWAY PREPARATION OF ANHYDROUS UO_2F_2. G. O. Morris. July 16, 1944. Decl. Aug. 11, 1949. 5p. (BR-442A; BDDA-217; R/GC/896/38)

A new method of preparing anhydrous UO_2F_2 consists in reacting UO_3 with HF gas at 400°C. The product contains 96.11% UO_2F_2 and 3.29% insolubles, the latter being essentially copper scale deriving from the reactor. The anhydrous product is a very pale-yellow hygroscopic solid. Suggestions for further research to develop the process are included.

1545

ON THE VISCOSITY OF THE URANIUM HEXAFLUORIDE. Kunihiko Kigoshi. Bull. Chem. Soc. Japan 23, 67-8(1950) July.

The viscosity of UF_6, obtained by the reaction between F_2 and uranium carbide, was measured, the observed values being 162.7×10^{-4} poise at 14.5°C, 169.9×10^{-4} at 26.3°, 175.7×10^{-4} at 35.2°, and 182.5×10^{-4} at 44.7°. The purification of UF_6 was performed by several repeated sublimations. An oscillating-disk viscosimeter was used in this experiment. The molecular diameter of UF_6 was determined to be 4.20 A from the Sutherland's equation constant, and the rigidity of the molecule, 4.03, was also obtained from the observed values. (auth)

ENGINEERING

1546

Naval Research Laboratory
SURFACE CHEMICAL PHENOMENA IN LUBRICATION. J. E. Brophy and W. A. Zisman. June 20, 1950. 30p.

Recent research is reported on adsorption of long-chain compounds. Rust-inhibitive properties of amphipathic films as a tool for studying adsorption, the relation of rust inhibition to wear prevention, colloidal phenomena in nonaqueous liquids, and boundary lubricating properties of aliphatic esters are discussed. 49 references.

1547

A THERMAL PRECIPITATOR FOR THE GRAVIMETRIC ESTIMATION OF SOLID PARTICLES IN FLUE GASES. J. Bredl and T. W. Grieve. J. Sci. Instruments 28, 21-23(1951) Jan.

The instrument described is designed to collect all the solid matter from a representative sample of flue gases, and to handle a sufficiently large sample of gas for the deposit to be easily weighed. Its advantages over the usual filtering methods are that it does not offer excessive resistance to the gas flow and that it is apparently capable of retaining the smallest size of particle present in flue gases. In addition, the use of aluminum-foil collecting surfaces facilitates accurate weighing, since, unlike the usual filtering materials, their capacity for adsorbing moisture is negligible. (auth)

HEAT TRANSFER

1548

University of California Department of Engineering
BOILING STUDIES; ANNUAL PROGRESS REPORT II; ADVANCE COPY OF CHAPTER III, SECTION A. BOILING HEAT TRANSFER FROM VARIOUS METALS TO WATER IN AN ANNULAR FLOW SYSTEM. A. G. Guibert and F. E. Romie. Aug. 1950. 50p. (COO-24)

Experimental investigation has been made of boiling-heat transfer to water from heated stainless steel, nickel, brass, and copper surfaces in a flow system in which the water being circulated was below the saturation temperature. The results indicated that the effects of the different metals, if any, were masked by other influences. Mathematical analysis of the problem showed that the boiling-heat-transfer data could be affected by the use of alternating current to heat the metal surfaces. Two other results were that the wall temperature of the heated surface was not independent of the distance from the test-section entrance, and that the boiling-heat transfer was a function of velocity. (auth)

VACUUM SYSTEMS

1549

A ROTARY McLEOD GAUGE. M. Axelbank. Rev. Sci. Instruments 21, 511-13(1950) June.

An abstract of this paper appeared in Monthly Abstract Bull. (Eastman), 559-60(1950) Nov. and is reproduced here in its entirety.

The use of the sensitive McLeod gauge is limited by its fragility, bulk, and lack of portability. A new type of McLeod gauge is described which greatly reduces these limitations. A helix of several turns of glass tubing provides the volume through which the gas is compressed by a small quantity of Hg as the gauge is rotated upon its rotary seal. A model has been constructed which is 16 by 16 by 21 cm in over-all dimensions and weighs less than 1 kg. Its gauge constant, with a 0.8-mm capillary, is 1.4×10^{-6} mm^{-2}.

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

1550

Massachusetts Institute of Technology
PROGRESS REPORT FOR APRIL 1 – JUNE 30, 1950. F. H. Norton. June 30, 1950. 11p. (NYO-770)

Various designs for fitting a heating coil on an inductively heated tester, testing uniformity of heating, tests using induction heating and pyrometer temperature measurements, etc., are reported. Determinations of thermal conductivities of sintered alumina and sintered magnesia in low and intermediate temperature ranges are described and results tabulated.

1551

PORCELAINS WITHIN THE BERYLLIA FIELD OF THE SYSTEM BERYLLIA-ALUMINA-ZIRCONIA. S. M. Lang, L. H. Maxwell, and M. D. Burdick. J. Research Natl. Bur. Standards 45, 366-73(1950) Nov.

An abstract of this paper appeared in Tech. Data Dig. 16, No. 2, 40(1951) Feb. and is reproduced here in its entirety.

The general physical properties of practically impervious porcelains within the beryllia (BeO) field of the system beryllia-alumina-zirconia (BeO-Al_2O_3-ZrO_2), whose base compositions approximate that of NBS Body No. 4811C, were found to be: maturing range, 1500 to 1600°C; apparent density, 2.9 to 3.4 g/cm^3; shrinkage, 17.8 to 20.5%; room-

temperature compressive strength, 238,000 to 305,000 psi; room-temperature transverse strength, 17,200 to 34,100 psi; room-temperature transverse strength after thermal shocking, 17,800 to 31,900 psi; transverse strength at 1800°F (982°C), 15,100 to 25,100 psi; approximate Young's modulus at 1800°F, 28,000,000 to 38,000,000 psi; relative thermal shock resistance, good; and Knoop hardness numbers (500-g load), 550 to 830. An admixture of 2 wt % of calcia (CaO) to the base compositions of these porcelains (without which the specimens would not mature to an impervious structure) caused the appearance of unidentified isotropic phases.

GEOLOGY AND GEOPHYSICS

1552

Office of Naval Research, London
GEOPHYSICAL RESEARCH AT THE UNIVERSITY OF ROME. Thomas Coor. July 12, 1950. 4p. (ONRL-71-50)

The research on natural radioactivity in connection with geology being carried out at the University of Rome, including determinations of the age of organic specimens by measuring the C^{14} activity with a special counter, of the agent responsible for the radioactivity in volcanic rocks, and of the isotopic abundance of argon from volcanic rocks, is briefly described.

1553

HEAT FLOW IN THE EARTH. S. K. Runcorn. Nature 166, 974-6(1950) Dec. 9.

The papers presented at a meeting of the British Association, Mathematics and Physics Section, on September 4, 1950, are summarized. The thermal state of the earth in relation to the radioactive decay of K^{40} and the uranium and thorium series, and geomagnetic secular changes attributed to thermal convection in the earth's core were discussed. 11 references.

1554

RADIOACTIVITY OF THE BOURLAMAQUE, ELZEVIR, AND CHEDDAR BATHOLITHS, CANADA. W. N. Ingham and N. B. Keevil. Bull. Geol. Soc. Am. 62, 131-48(1951) Feb.

A concentration of radioactivity toward the outer margin of batholiths, not related to invaded rock, has been shown in six of nine intrusive studies in three areas. The difference in radiogenic heat-producing power of the rocks in southeastern Ontario (2.9 cal/g/10^{9} yr) and western Quebec (0.8 cal/g/10^{9} yr) should lead to observable differences in the geothermal gradient and the present surface heat flow. Representative sampling of batholiths for radioactivity investigations requires attention to all exposed parts, examination of invaded rock, and knowledge of the section represented by the present erosional level. In the series of related intrusives comprising the Elzevir composite batholith, an increase in specific radioactivity was found in the change from basic to later acidic rocks, culminating with pegmatites; an intermediate gray granite, however, accounted for 64% of the radioactivity of the primary magma. Characteristic radioactivities of members of an intrusive series may be used as a criterion for correlation. (auth)

METALS AND METALLURGY

1555

Dow Chemical Co.
QUARTERLY STATUS REPORT; AUGUST 1, 1950–NOVEMBER 1, 1950; ROOM AND ELEVATED TEMPERATURE PROPERTIES OF POWDER EXTRUDED MAGNESIUM ALLOYS CONTAINING ALUMINUM, BERYLLIUM, AND ZIRCONIUM. 1950. 23p. (COO-20)

The high strength properties of extruded powder mixtures of KO alloy and aluminum or Mg-Al alloys have been confirmed. Furthermore, the high properties are enhanced by heat treating at 750°F. The effect of various aluminum-containing additions on the properties of KO alloy is shown. The properties of these alloys decrease rapidly with increasing temperature of test but the aluminum-containing mixtures retain their superiority over KO. A homogenizing heat treatment applied to KO powder markedly lowers the strength properties of extruded mixtures made with KO so-treated. Results of a few creep tests on these alloys are presented. (auth)

1556

General Electric Research Laboratory
TRACER AND OTHER TECHNIQUES OF DIFFUSION MEASUREMENTS. R. E. Hoffman. Oct. 1950. 27p. (SO-2010; RL-448)

In addition to a review of tracer techniques for the measurement of diffusion coefficients in metals, techniques involving progressive fusion of a point, thermionic emission, evaporation of a volatile component, micrography, sectioning, microhardness, and photoelectric emission are discussed.

1557

THE AEC IN SOLID-STATE METALLURGY. D. W. Lillie. Nucleonics 8, No. 1, 17-23 (1951) Jan.

Early in 1948 the AEC began to encourage sound proposals for metallic-state research. The integrated program that was built around the resulting basic research is discussed in detail, together with examples of the progress to date. (auth)

1558

HEAT TREATMENT AND STRUCTURE OF COMMERCIAL TITANIUM. J. Maltz and V. DePierre. Metal Progress 58, 862-6(1950) Dec.

An abstract of this paper appeared in Tech. Data Dig. 16, No. 2, 38(1951) Feb. and is reproduced here in its entirety.

The solubility of carbon in either α or β Ti is very much less than 0.78% over a wide range of temperature. The addition of carbon to Ti and the pick-up of atmosphere O_2 and

N_2 widen the temperature range of the α-β transformation. β Ti is not retained in appreciable quantity when commercial Ti is quenched, nor is a hard transition phase formed. The material consequently is not hardened by quenching. The microstructure of quenched Ti bears some resemblance to that of martensite. The hardness of quenched Ti is not greatly affected by tempering. No change in structure occurs except for a gradual fading of the martensitic pattern and emergence of a pattern of resolvable α Ti grains.

1559

LESS COMMON METALS. D. B. Broughton. Ind. Eng. Chem. 42, 2023-5(1950) Oct.

A brief review of progress during the past year on processes, availability, and properties of titanium, zirconium, tantalum, and noble metals is presented. 48 references.

1560

ON THE THEORY OF DIFFUSION IN METALS. Frederick Seitz. Acta Cryst. 3, 355-63(1950) Sept.

Zener has generalized the interchange mechanism of metallic diffusion by considering interchange processes in which more than two atoms may change places at once. The position of these calculations relative to those of Huntington and Seitz on the mechanism of diffusion is discussed. It is emphasized that the calculations still favor the vacancy mechanism, although the purely theoretical support is not as overwhelming as it seemed to be previously. The experimental situation is reviewed. It is pointed out that the existing experiments on the Kirkendall effect, which is concerned with the motion of fiducial markers during diffusion, and the diffusion of minor additions in substitutional alloys strongly support either a vacancy or interstitial mechanism and exclude a direct interchange mechanism as the major contributing process. Taken as a whole the theoretical and experimental evidence supports the vacancy mechanism as previously. Bardeen's derivation of Darken's relations between the chemical diffusion coefficient and the diffusion coefficients of individual atoms is examined somewhat more generally in an appendix. (auth)

1561

PLASTIC BIAXIAL STRESS-STRAIN RELATIONS FOR ALCOA 24S-T SUBJECTED TO VARIABLE-STRESS RATIOS. Joseph Marin and B. J. Kotalik. J. Applied Mechanics 17, 372-6(1950) Dec.

Usually, plastic biaxial stress-strain relations for metals have been determined for tests in which the ratios of the principal stresses have been maintained essentially constant. This paper presents biaxial plastic stress-strain relations for both constant and variable-stress ratios. The purpose of conducting the variable-stress-ratio tests is to attempt to prove whether the flow- or deformation-type theory is the correct theory for predicting plastic stress-strain relations. The paper also gives a comparison between the actual and theoretically predicted values of the biaxial yield, ultimate and fracture strengths, and the biaxial ductility. Various ratios of biaxial tensile stresses were investigated by subjecting tubular specimens to axial tension and internal pressure. The test results showed that the yield-strength values agree best with the distortion-energy theory. For the prediction of the plastic stress-strain relations the deformation-type theory was found to be in approximate agreement with the test results for both the constant- and variable-stress-ratio tests.

1562

RING DIFFUSION IN METALS. Clarence Zener. Acta Cryst. 3, 346-54(1950) Sept.

The concept of hole migration in metals as the mechanism of self-diffusion and of diffusion of substitution-solute atoms has arisen from the apparent failure of other reasonable mechanisms, such as direct interchange, to give heats of activation comparable to those observed. In the present paper it is pointed out that diffusion by direct interchange is only a special case of diffusion by the synchronized cyclic motion of a number of atoms, herein called ring diffusion. General arguments are presented demonstrating that a 4-ring has a lower potential-energy barrier for cyclic motion than has a 2-ring, which corresponds to direct interchange. These general arguments are supported by detailed calculations for the particular case of self-diffusion in copper. It is concluded that such ring diffusion is not excluded by energy considerations. (auth)

1563

Air Materiel Command
STRESS RUPTURE TESTS ON SHEET ALLOYS FOR HIGH TEMPERATURE APPLICATIONS. I. Perlmutter. July 1950. 40p. (AF-TR-6188)

Stress-rupture tests at 1500°F were conducted on six alloys of different bases and on eight stainless steel modifications, all in sheet form. Rupture tests at 1200°F were also made on one of the stainless steel modifications to complete the comparison at that temperature. In addition, the sheet alloy V-36, an Air Force development, was evaluated in stress-rupture at 1700 and 1800°F. Metallographic studies were made on all materials before and after rupture tests, and the effect of the latter on residual ductility was measured approximately.

MINERALS AND MINERALOGY

1564

Atomic Energy Commission
SOME FEATURES OF THE SECONDARY REDISTRIBUTION OF URANIUM IN OXIDATION ZONES. Donald L. Everhart. Nov. 16, 1950. 12p. (AECU-1036)

Attention to low-grade secondary uranium deposits in arid zones of intense oxidation may be concentrated on deposits with the following geologic characteristics: (1) strong, persistent, tensional fractures of a type that may have been favorable for the upward passage of hydrothermal solutions from below; (2) fracture filling by metallic minerals that may have been derived from sulfides of base metals, and gangue minerals that are typical of hydrothermal deposits (ferric oxides appear to be the most persistent associated metallic mineral at the surface); (3) uranium minerals that include base metals in their lattice; (4) wall rock which

may have been altered in part to clays with high base change properties as well as kaolinite, and wall rock affected by chloritization or sericitization, and by silicification. Secondary uranium deposits of this type indicate a chance for extensions into relatively less oxidized portions of the earth's crust where the deposits may contain primary uranium minerals. Whether such primary deposits themselves contain economic ore is a problem which can be solved only by study and development of each individual deposit.

1565

DETERMINATION OF URANIUM IN ORES. F. T. Rabbitts. Can. Chem. Process Inds. 34, 981-2, 984-5(1950) Dec.

Four possible methods are described for the determination of U in ores. Particular emphasis is placed on the microfluorimetric method.

1566

Department of Mines and Technical Surveys, Mines Branch, Ottawa
EQUILIBRIUM DETERMINATIONS ON LOW GRADE ORES. (SPECIAL REPORT NO. 25/50). C. Lapointe. May 10, 1950. 7p. (NP-1783)

Apparatus for testing the state of radioactive equilibrium of low-grade mill concentrates is described. Following calibration and listing of specific activities and relations of U_3O_8/ThO_2, ThO_2/K_2O, and U_3O_8/K_2O in terms of beta and gamma radiation, it is indicated that the ratio beta/gamma which should be constant for month-old samples varies with the history of the sample. A loss of radium in milling processes is inferred. Factors are also suggested to account for variations in ratio of gamma and beta activities between two sets of data.

1567

LITHIUM AND THE HYDROGEN BOMB. Jack De Ment. Eng. Mining J. 152, No. 1, 83(1951) Jan.

Brief references to the fusion principle with light elements and the conversion of lithium into tritium and deuterium in nuclear reactors are made. Occurrences of lithium-bearing minerals and ores in the United States are indicated.

1568

MONAZITE AREAS. Isaac Ohana. Resenha econ. (Rio de Janeiro) 3, No. 9, 31-7(1950) Sept. (In Portuguese)

Statistical information is given on the extent and exploitation of monazite deposits of Brazil. A few data on uranium sources are included.

PHYSICS

1569

Iowa State College Ames Laboratory
PROGRESS REPORT IN PHYSICS FOR THE PERIOD OCTOBER 1, 1949, TO JUNE 30, 1950. G. W. Fox, W. C. Caldwell, J. F. Carlson, G. C. Danielson, E. N. Jensen, J. K. Knipp, J. M. Keller, L. J. Laslett, S. Legvold, G. Miller, and D. Zaffarano. Sept. 25, 1950. 33p. (ISC-104)

A number of β and γ radioactivities have been studied with a thin magnetic lens spectrometer. Results of particular interest include the correction to the shape of once forbidden β spectra from nuclides of large Z values, a 29-day week β activity associated with P^{32}, and the large number of γ-rays in the decay of Yb^{169}. An existing discrepancy in mass distributions as determined by chemical analysis and ionization measurements is partially explained by assuming a different energy per ion pair produced by the light and heavy fission fragments. A study of diamond conduction counters has shown among other effects a stabilization of the crystals at a high counting rate after irradiation with violet light. Correlations have been sought but not found between counting ability and optical properties of diamonds. Increase of electrical resistance of diamonds with pressure at room temperature is interpreted as experimental evidence for the existence of surface states. Study of the structure of ferroelectric $BaTiO_3$ has revealed experimentally for the first time displacements of the O and Ti ions. Further work in solid state physics deals with conductivity and Hall coefficient determinations in crystals of boron and sodium tungsten bronze, and work preparatory to study of dislocations, diffusion, piezoelectric, and elastic constants. 35 references. (auth)

1570

CHARGE EXCHANGE BETWEEN IONS AND ATOMS OF MERCURY. B, M. Palukh and L. A. Sena. Zhur. Eksptl'. i Teoret. Fiz. 20, 481-91(1950) June. (In Russian)

Among interactions between atoms and ions of a gas, charge exchanges (one-electron exchanges) have by for the highest probability. Measurements of effective cross sections were made on mecury vapors in the ion-energy interval 32 to 1400 ev. Besides the usual method of a retaining field (Penning et al., Z. Physik 62, 746(1930)), two modifications were used, viz., the method of a constant ion velocity and that of a constant collector potential (the latter is the most advantageous). Systematic measurements at 75, 165, 425, and 990 ev, gave, respectively, the following values of the cross section: 351, 316, 286, and 258 $cm^2/cm^3/mm$ Hg. Values at other energies agree with the trend of the systematic series, so that the general result is a slowly descending curve, reaching, at high ion velocities, the value 174 $cm^2/cm^3/mm$ Hg (calculated without allowing for the tunnel effect). (auth)

1571

THE ELECTRICAL CONDUCTIVITY OF BISMUTH FIBRES. II. ANOMALIES IN THE MAGNETO-RESISTANCE.

B. Donovan and G. K. T. Conn. Phil. Mag. (7) 41, 770-82 (1950) Aug.

In examining the magneto-resistance of thin fibers of bismuth, which are known from previous work to approximate to single crystals, it was found that a considerable proportion of these, about 10%, showed a decrease in the resistance on application of a magnetic field. The effect is present only in fields of the order of 1000 gauss or less and is of the order of $10^{-4}\rho_0$. The influence of direction of current, direction of field, and orientation of the crystal axes is examined. It is considered that these observations provide the first unequivocal evidence of the existence of a longitudinal Hall coefficient. Used in conjunction with the theory of conduction in anisotropic solids, it is possible to indicate the appropriate crystal orientation. It has not as yet been possible to designate this with accuracy.

1572

Columbia Radiation Laboratory
FIRST QUARTERLY PROGRESS REPORT FOR THE FISCAL YEAR 1950-1951. Sept. 30, 1950. 31p. (NP-1858)

Generation of High Frequencies. Work during this quarter on magnetron construction, enhanced emission from magnetron cathodes, and magnetron space-charge experiments is reported.

Microwave Apparatus and Techniques. Brief statements are made of the status of work on the mechanical spectrum analyzer, standing-wave machines and tuners, crystals, harmonic generators, and the microwave interferometer.

Microwave Physics. Some results are reported on studies of electron polarization, resonance modulation, high-temperature microwave spectrometry, microwave spectrum of CHD_2Cl, zero-field nuclear quadrupole resonant lines of Cl^{35} and Cl^{37}, quadrupole-moment ratio of Cl^{35} and Cl^{37}, and the mass difference ratio $S^{33} - S^{32}/S^{34} - S^{32}$.

1573

INFLUENCE OF ELECTRIC FIELDS ON THE LIFETIME OF THE METASTABLE LEVEL OF THE HYDROGEN ATOM. Gerhart Lüders. Z. Naturforsch. 5a, 608-11(1950) Nov. (In German)

The discovery of the Lamb shift (Lamb and Retherford, Phys. Rev. 72, 241(1947)) and its explanation as the result of an interaction between the electron and the radiation field (Bethe, Phys. Rev. 72, 339(1947); Welton, Phys. Rev. 74, 1157(1948)) motivated a recalculation of the effect of electric fields on the lifetime of the metastable level $2\,S_{1/2}$ of the hydrogen atom. It is found that, in the interval 0.03 to 10 v/cm, the Lamb shift prolongs the lifetime by a factor exceeding 10^3. (auth)

1574

New York University
PROGRESS REPORT 2 ON FLUORESCENCE AND CONDUCTIVITY PHENOMENA. Hartmut Kallmann. July 1950. 86p. (NP-1819)

Fluorescence of Organic Solutions and Crystal Powders. Numerous experiments on use of large quantities of solution; efficiencies as function of concentration of a large number of dissolved compounds in xylene, phenylcyclohexane, p-dioxane, paraffin oil, benzene, toluene, naphthalene, o-diphenylbenzene, and other solvents; influence of impurities on light output; ultraviolet-light emitters; and efficiencies of light emission of crystal powders are reported, with some theoretical considerations on energy transfer. Some preliminary studies on detection of fission in uranium salts dissolved in xylene-dioxane-terphenyl solution are presented.

Time-constant Measurement with Different Fluorescent Materials. An apparatus permitting the measurement of light emission as a function of the time over time intervals from 0.01 to 100 μsec is described.

Induced Conductivity in Insulating Crystals. Experimental results and theoretical considerations indicate that quite different types of transport of charge occur in insulators. In some cases a true conductivity induced by exterior radiation occurs, in other cases removal of the charge excited inside the material by the exterior radiation occurs.

1575

New York University
PROGRESS REPORT 3 ON FLUORESCENCE AND CONDUCTIVITY PHENOMENA; JULY, AUGUST, SEPTEMBER, 1950. Hartmut Kallmann. Oct. 1950. 38p. (NP-1934)

In previous reports, experiments on the light emission of dilute organic solutions excited by high-energy radiation were described, and a theory was developed to explain the phenomena observed (H. Kallmann and M. Furst, Phys. Rev. 79, 857(1950)). It was found that small amounts of solute molecules (of the order of 1 g/l) are already enough to increase the light emission of the pure solvent by as much as a factor of 35 and probably more. This phenomenon was explained by assuming a transfer of energy from the excited solvent molecules to the solute molecules. Sections B and C of this report are concerned with further experiments bearing out the theory proposed in the previous reports. In section C the emission spectra of a number of crystals and solutions are described. These latter spectra and their shift by small amounts of "impurities," play an important role in the theory. Solutions with strong absorption always show shifts of the spectrum of the emitted light of the original solution to that of the spectrum of the absorbing solute. Section D describes experiments with mixed solutions where practically no absorption occurs, but where the maximum intensity of the emitted light and the concentration for maximum intensity are changed by the addition of fairly small amounts of an additional solute. Here a new process of energy transfer which, however, fits very well into the general scheme proposed in this paper is assumed. By means of these experiments the transfer processes can be followed in greater detail.

1576

M.I.T. Laboratory for Nuclear Science and Engineering [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950]. J. R. Zacharias, E. R. Gilliland, M. M. Hubbard, and C. C. Foster. July 1, 1950. 228p. (NP-1777)

Separate abstracts have been prepared on the following sections of this report: Chemistry of the Fission Elements Group, p. 3-10; Cosmic Ray Group, p. 11-22; Elementary

Particle Scattering Group, p. 23-40; 12-Mev Generator Construction and High-Voltage Research Group, p. 41-50; Nuclear Chemistry (Inorganic) Group, p. 51-84; Nuclear Chemistry (Organic) Group, p. 85-90; Nuclear Cross-Sections Group, p. 91-130; Radioactivity and Cyclotron Group, p. 131-86; Synchrotron Group, p. 187-98; Theoretical Group, p. 199-202.

1577

SOME RARE EARTH ACTIVATED PHOSPHORS. H. G. Jenkins and A. H. McKeag. J. Electrochem. Soc. 97, 415-19(1950) Dec.

Two classes of rare-earth-activated phosphors having interesting and unusual properties are described. The first series, consisting of alkaline-earth silicates activated by divalent europium, shows a wide range of fluorescent colors when excited by 3650-A radiation. Some of these compounds are characterized by the stability of their fluorescence at comparatively high temperatures. The second class of phosphors, consisting of alkaline earth pyrophosphates activated by dysprosium and samarium, has unusual phosphorescent characteristics when excited by cathode rays. (auth)

1578

SPIN-LATTICE RELAXATION IN SOME PARAMAGNETIC SALTS. R. J. Benzie and A. H. Cooke. Proc. Phys. Soc. (London) 53A, 201-12(1950).

The magnetization of a paramagnetic salt is a relaxation process with a relaxation time depending on the external field and temperature. Measurements have been made with the object of determining relaxation times at various fields and temperatures in the liquid-helium range. A description of the apparatus is given. The results show that paramagnetic relaxation is a complex phenomenon and suggest that in any one specimen it must be described in terms of a distribution of relaxation times rather than a single relaxation time. In general, it is found that relaxation times are of the order of 10^{-2} sec, with a temperature dependence varying according to a power of 1/T between 2 and 3 and increasing with the external field H according to a power of H between 0 and 1. 12 references. (auth)

1579

Yale University
TECHNICAL REPORT NO. 2. C. T. Lane. Nov. 1, 1950. 72p. (NP-1814)

Work in low-temperature physics carried out during 1949-50 by Yale University is collected in this report. In addition to 14 reprints from the published literature, two as yet unpublished experiments are reported.

Rollin Film Transport. The transport rate of pure liquid He^4 and of various mixtures of He^4 and He^3 have been measured in an apparatus in which the He^3-He^4 ratio does not change appreciably. Platinum wires of 3-, 4-, and 10-mil diameter imbedded in pyrex were used as superleaks, the assumption being made that the Rollin film covered the glass wall alone. Anomalous results of abnormally high transport rates for pure He^4 between the λ point and 1.5°K, very marked rise in the transport rate below 1.5°K and absence of these effects for He^3-He^4 mixtures were observed. The reasons for these anomalies are discussed, and some experiments on thermal effects are reported. 3 figures.

Second Sound in He^3-He^4 Mixtures. Since the behavior of second sound depends strongly on the normal-component density of He II, small amounts of dissolved He^3 should substantially affect this phenomenon. Velocity measurements on mixtures of He^3 and He^4 have been made by a pulse method. The results are in general agreement with the theory. 4 figures.

1580

V-CENTERS IN ALKALI HALIDES. Ruth Casler, Peter Pringsheim, and Philip Yuster. J. Chem. Phys. 18, 1564-71(1950) Dec.

V-centers are defined as stabilized positive holes. The peak wavelengths of three V-bands of KCl, KBr, and NaCl are listed. Most of this paper deals with KCl, but the results are typical for KBr and NaCl as well. Experimental data are given concerning the conditions under which the various V-bands are obtained and their unequal stability with regard to bleaching by light and temperature. Crystals irradiated at various temperatures and observed at room temperature show superpositions of the V_2- and V_3- bands with relative intensities depending greatly on the temperature at which the crystals were irradiated and on the nature of the primary radiation. The V_1- band can be observed only at temperatures below −100°C. These data are compared with those published by other investigators, and some remarks are made concerning the possible mechanisms which are responsible for the various phenomena. (auth)

COSMIC RADIATION

1581

CLOUD CHAMBER OBSERVATIONS ON THE ELECTROMAGNETIC COMPONENT FROM NUCLEAR EXPLOSIONS AND THE DEVELOPMENT OF THE NUCLEAR CASCADE. A. Lovati, A. Mura, G. Salvini, and G. Tagliaferri. Nuovo cimento (9) 7, 943-53(1950) Nov. 20.

The electromagnetic component and the evolution of nuclear cascades in cosmic-ray nuclear explosions were observed at 3500-m altitude in a counter-controlled cloud chamber. On the assumption that the electromagnetic component is due to a decay of neutral mesons emitted during the explosions, an energy spectrum of neutral mesons was obtained which is poorer in high-energy events than that derived recently from photoemulsion experiments by Carlson et al. (Phil. Mag. (7) 41, 701(1950)). As to the problem of the evolution of a nuclear cascade, the facts seem to be better described by the Heitler-Jánossy plural theory of meson production, or by a recent theory of Fermi, than by that of Wouthuysen, who, on the basis of Heisenberg's postulate of a multiple production, has examined the extreme case of a completely inelastic nucleon-nucleon collision. (auth)

1582

CONSIDERATIONS ON THE CASCADE-LIKE ORIGIN OF THE PENETRATING COMPONENT OF EXTENSIVE SHOWERS. A. Borsellino and G. Salvini. Nuovo cimento (9) 7, 790-4(1950) Sept. 25. (Letter to the editor; in Italian)

If one accepts the picture of a cascade-like multiplication of nucleons generating nuclear disintegrations in air as an essential part of the phenomenon of extensive showers, it seems necessary to investigate that picture's concordance with one or another of the existing views on the production of mesons during nuclear collisions. Such an investigation shows that, while, in general, the single-production hypothesis better interprets the now available facts than does the multiple-production theory, the former is inadequate in cases when very high energies are involved. It is impossible to see, so far, where and how the two theories will be found to blend; however, the situation does not seem to require the introduction of new hypotheses or new particles.

1583

M.I.T. Laboratory for Nuclear Science and Engineering COSMIC RAY GROUP, p.11-22 of [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950]. Bruno Rossi and G. E. Valley. July 1, 1950. 12p. (NP-1777)

Work during the past year on shower production by penetrating particles; observations with the large square, the high-pressure, and the 12-in. cloud chambers; balloon-borne experiments; air showers; specific ionization; scintillation counters; short-pulse detection of synchrotron mesons; and π^+ meson lifetime is summarized.

1584

THE ELECTRON COMPONENT OF EXTENSIVE AIR SHOWERS. Yoichi Fujimoto, Satio Hayakawa, and Yoshio Yamaguchi. Progress Theoret. Phys. (Japan) 5, 196-206 (1950) Mar.-Apr.

The applicability of quantum electrodynamics and of the meson model to the phenomenon of extensive atmospheric showers is tested where extremely high energy values are involved. The behavior of the electron component alone is examined, and it is assumed that the proton is the primary ray and that electrons are produced in nuclear collisions according to one (or both) of the plausible processes of the γ decay of neutral mesons and of the charge exchange. It is concluded that the density spectrum of the primaries can be extrapolated from lower energies, and that the quantum electrodynamics of electrons and photons is valid in the energy range displayed in the extensive showers.

1585

EMISSION OF HEAVY FRAGMENTS IN NUCLEAR EXPLOSIONS. D. H. Perkins. Proc. Roy. Soc. (London) 203A, 399-417(1950).

Observations have been made on the energetic nuclear fragments emitted in giant cosmic-ray stars. The disintegrations were produced in the heavy nuclei of Ilford C2 and G5 emulsions exposed at high altitude. Methods are described for the identification of the fragments, both stable and unstable, with charges between 3 and 10 units. It is found that fragment emission may be interpreted in terms of an asymmetric fission process which is highly probable when the nuclear excitation energy becomes comparable with the binding energy. The average kinetic energies of the fragments are considerably greater than those to be expected from the Coulomb repulsion, a fact which may be explained in terms of specifically long-range nuclear forces. The fragments exhibit a peculiar tendency to be emitted in directions prependicular to the incident star-producing particle. The mass of the emitted fragment does not depend appreciably on the size of star. At present there appears to be no comprehensive theoretical explanation of the precise mechanism of emission of such particles. 20 references. (auth)

1586

AN INDIRECT INFLUENCE OF SOLAR ACTIVITY ON THE INTENSITY OF COSMIC RADIATION. E. G. von Roka. Z. Naturforsch. 5a, 517-30(1950) Oct. (In German)

A survey of existing attempts to explain the 27-day variation period in cosmic radiation is followed by an exposition of a new theory based on a correlation between this period and changes in the sun-spot and calcium-flocculus solar activities. The latter are known to be linearly related to changes in the sun's ultraviolet activity, and since this ultraviolet radiation is absorbed in the upper part of the ozone layer of the atmosphere, large temperature variation, and consequently pressure changes, take place in those regions. On the other hand, recent observations locate in these altitudes the formation of about ⅓ of the meson component of cosmic rays, and it can be shown, by taking into account the foregoing temperature and pressure variations and the lifetime of the meson, that the observed periodic changes are quantitatively accounted for by the variations in the ultraviolet activity of the sun, itself (as stated above) correlated with the latter's spot and flocculus activities. A similar correlation (correlation coefficient = −0.91) can be established between the 11-yr period of sun-spot activity and a recently observed variation in cosmic-ray intensity (Lange and Forbush, Carnegie Inst. Wash. Pub. 14, 175(1948)).

1587

LATITUDE EFFECT OF COSMIC RAY STARS. S. Lattimore. Phil. Mag. (7) 41, 961-3(1950) Sept.

Ilford 200-μ G5 emulsions were exposed vertically for 27 days at altitudes of 11,550 and 41,400 ft at a latitude of approximately 12°S, in the Bolivian Andes. The plates were exposed under a corrugated-iron roof. Since the time required for transporting the plates to and from Bolivia was considerable, control plates of similar type to those actually exposed were used to find the number of stars collected before and after the exposure. Results indicate ratios (Jungfrau/Andes) of 2.1 ± 0.4 at 11,550 ft and 2.05 ± 0.27 at 14,400 ft, for the number of stars with more than three prongs. Star-size distribution shows that the latitude effect decreases as the star size increases.

1588

THE MEAN FREE PATH OF THE N COMPONENT OF THE COSMIC RADIATION. G. Salvini. Nuovo cimento (9) 7, 786-9(1950) Sept. 25. (Letter to the editor)

The complicated nature of nuclear explosions, as revealed by the photoemulsion and cloud-chamber techniques, makes it difficult to arrive at an unambiguous determination of the nuclear mean free path $1/n\sigma$ (σ is the total cross section per nucleus for nuclear interaction, and n is the number of nuclei per gram). However, a critical examination of the methods employed (photoemulsion and cloud-chamber pictures and combinations of filters and counter groups) shows that the available data may be regarded as consistent, provided due allowance is made for the limitations of the techniques.

1589

ON THE DEVELOPMENT OF THE NUCLEON COMPONENT OF THE COSMIC RADIATION IN AIR. H. Messel and D. M. Ritson. Proc. Phys. Soc. (London) 63A, 1359-65(1950) Dec. 1.

The development of the nucleon component in air is considered in terms of a model which is an extension of that proposed by Heitler and Jánossy. The numerical results obtained are compared with experiment, and good agreement is found. (auth)

1590

PENETRATING PARTICLES IN AIR SHOWERS. C. B. A. McCusker. Proc. Phys. Soc. (London) 53A, 1240-7(1950).

The penetrating particles in extensive air showers are compared directly with the penetrating particles in the main cosmic-ray beam. It is found that not more than $70 \pm 3\%$ of the air-shower particles are single μ mesons, whereas the remainder are strongly interacting particles. The barometer coefficient of extensive penetrating showers has been determined. (auth)

1591

SOME RARE COSMIC-RAY PHENOMENA OBSERVED IN PHOTOEMULSIONS. L. Gillon, F. Gillain, and A. Melin. Ann. soc. sci. Bruxelles 64, Sér. I, 196-200(1950) Dec. 13. (In French)

The following nuclear events were recorded in Ilford G5 and C2 emulsions exposed in high mountains: double stars, capture and disintegration of mesons, proton captures, showers, and passages through nuclei. 2 photographs. (auth)

ELECTRONS

1592

ELECTRON PAIR PRODUCTION DURING RADIOACTIVE DECAY; trans. from Zhur. Eksptl'. i Teoret. Fiz., VII, No. 6, p.696-713, June, 1937. B. V. Tissa. May 26, 1950. 29p. (NP-2157)

According to Dirac's theory, an electron in the negative energy state may, when sufficiently disturbed, transfer to the positive energy state thus forming the so-called "pair." In this work the perturbation theory to the first approximation is employed to study the probability of pair production.

1593

FLUCTUATIONS OF THE ELECTRON-PHOTON CASCADE; MOMENTS OF THE DISTRIBUTION. L. Jánossy and H. Messel. Proc. Phys. Soc. (London) 63A, 1101-15(1950) Oct. 1.

The second moments of the electron-photon cascades are evaluated. It is found that the mean square fluctuation at the cascade maximum is that expected for a Poisson distribution or less; before and after the maximum the fluctuation exceeds greatly that expected for a Poisson distribution. The correlation coefficient between electrons and photons is zero for small thicknesses or near the cascade maximum. For other regions the correlation coefficient is positive. Both mean square fluctuations and correlation electrons and photons can be understood qualitatively in terms of fluctuation of effective depth. (auth)

1594

ON THE POSSIBILITY OF STRIPPING ELECTRONS FROM METALS WITH STREAMS OF MOLECULES OF A NEUTRAL GAS HAVING ELECTRONEGATIVE PROPERTIES. S. V. Izmaĭlow and A. M. Furman. Zhur. Eksptl'. i Teoret. Fiz. 20, 729-33(1950) Aug. (In Russian)

It is generally admitted that no appreciable electric events result from collisions between molecules of an electrically neutral gas (under ordinary temperature and pressure conditions) and a solid surface, such as that of a metal. It is shown that by augmenting the molecules' kinetic energy and by using a neutral gas with electronegative valences, it should be possible to strip electrons from a metal surface through a "potential tunnel" transfer.

1595

PROCESSES BETWEEN LIGHT PARTICLES ACCORDING TO DIRAC'S THEORY. A REMARK ON B. KOCKEL'S WORK BEARING THE SAME TITLE. Peter Havas. Ann. Physik 7, 413-15(1950) July 20. (In German)

Kockel has stated recently (Ann. Physik 4, 279(1949); NSA 3-2365) that, in interactions between electrons and an arbitrary number of light quanta, no processes are possible in which more than one electron undergo state changes. It is shown here that this is true only if interactions between electrons are neglected. (auth)

GASES

1596

ON THE THEORY OF THE LORENTZ GAS MIXTURE. Ludwig Waldmann. Z. Naturforsch. 5a, 322-7(1950) June. (In German)

In the presence of molecular interactions of any kind, a Lorentz gas mixture, (a mixture containing a large number of heavy atoms and a small number of light ones), obeys the following two relationships of the diffusion coefficient D_{12}, the thermodiffusion factor a, the heat-conductivity coefficient of the mixture λ, and that of the heavy component in the pure state λ_2:

$$a = (\partial \ln D_{12}/\partial \ln T)_p - 2; \quad \lambda = n_1 D_{12} k(\tfrac{5}{2} + d(aT)/dT) + \lambda_2$$

(T is temperature, p pressure, n_i density of the atoms of the light component, and k the Boltzmann constant). The derivation of the second equation requires an approximate knowledge of the velocity distribution of the heavy atoms in the mixture; it is shown that this distribution is identical with that in the heavy component in the pure state. (auth)

INSTRUMENTS

1597

CHARACTERISTICS OF GERMANIUM DIODES. Bernard F. Osbahr. Tele-Tech 9, No. 12, 2, 33-4(1950) Dec.

An analysis of the technical specifications for 36 different, commercially available types of general-purpose diodes, matched duo-diodes, and varistors is presented.

1598

AN INPUT MULTIVIBRATOR FOR COINCIDENCES OF A HIGH RESOLVING POWER. P. Colombino. Nuovo cimento (9) 7, 955-60(1950) Nov. 20. (In Italian)

A six-channel coincidence circuit with a resolving power of less than 1 μsec has been constructed and used in research on penetrating showers. Each channel has a cathode-coupled input multivibrator unit for counter quenching, one of the two tubes of every unit acting also as a cathode follower and giving a low-impedance output. Each multivibrator is coupled directly to the Geiger counters, thus reducing to a minimum the input parasitic capacity and permitting an improved transmission of high-frequency components of the pulse. (auth)

1599

NOISELESS CIRCUIT FOR ANY FEED CURRENTS. W. Poppelbaum. Helv. Phys. Acta 23, 866-7(1950) Dec. 10. (Note; in French)

The use of RC filtering in modern electronic circuits, motivated primarily by reasons of economy, is being extended to measuring apparatus. However, the accompanying noise limits its use to low values of the feed current, since the elimination of the sound in the case of currents exceeding a few ma would require prohibitive resistances. A circuit is proposed which permits the extension of the noiseless RC filtering to currents of several dozens ma, by reducing the quality of the filtering (R is about 500 ohm instead of 10,000) and by using an appropriate electronic arrangement for the elimination of the sound; no additional tubes are needed.

ISOTOPES

1600

DETERMINATION OF THE MASS NUMBER OF THE 3.9-MIN ACTIVITY OF SELENIUM. A. Flammersfeld and W. Herr. Z. Naturforsch. 5a, 569-70(1950) Oct. (Note; in German)

In a recent note (Z. Naturforsch. 5a, 401(1950)) a very soft 3.9-min β activity of Se obtained through (n,γ) and (n,2n) processes was described, and the question was left open as to its attribution to Se^{77m}, Se^{79m}, or Se^{81m}. It is reported here that the same activity was obtained by way of the Br(n,p)Se reaction, using Li + D and Be + D neutrons. A discussion involving data on known products of the foregoing reaction, on intensities of observed activities other than 3.9 min, and on the reaction energies, points to the nuclide Se^{79m} as the most probable attribution; the corresponding ground state is unknown because of its presumably long lifetime and, consequently, very low β-decay energy.

1601

ISOTOPE ABUNDANCES OF BORON; A MASS-SPECTROMETRIC INVESTIGATION OF PRODUCTS OBTAINED FROM BF_3 AND BCl_3 THROUGH BOMBARDMENT WITH ELECTRONS. O. Osberghaus. Z. Physik 128, 366-77 (1950) Oct. 3. (In German)

Mass-spectroscopic measurements of isotope abundances of boron furnished the value 4.11 ± 0.02 for the ratio B^{11}/B^{10}; the deviations, as observed in six different minerals, did not exceed the experimental error (0.5%). The appearance potentials of ions from BF_3 and BCl_3 were also measured, and their relation to thermochemical data are discussed. Ionization functions differ very appreciably from ion to ion. (auth)

1602

Atomic Energy Project (Canada)
PILE-PRODUCED ISOTOPES. [nd.] 171p. (NP-1812)

Information on the isotopes available from or through the Canadian Atomic Energy Project at Chalk River, Ontario is presented in this catalogue. Charges, application forms, transportation requirements, and recommendations for laboratory design and instrumentation are included.

1603

SUPERCONDUCTIVITY OF TIN ISOTOPES. W. D. Allen, R. H. Dawton, J. M. Lock, A. B. Pippard, D. Shoenberg, Marianne Bär, K. Mendelssohn, and J. L. Olsen. Nature 166, 1071(1950) Dec. 23.

Measurements have been made of the superconducting transition temperatures and critical fields of nearly pure tin isotopes separated by the electromagnetic method; the mean atomic weights provisionally determined by mass spectrograph were 116.2 ± 0.2, 120.0 ± 0.2, and 123.6 ± 0.4. Transitions were studied (a) by observing the magnetic moment in a constant small magnetic field (2 gauss) as the temperature was lowered, and (b) by measuring magnetization curves at constant temperatures. The magnetic moments were measured by a ballistic method, and to improve relative accuracy all three samples were studied together. In addition, experiments on the magnetic susceptibility of tin isotopes are reported, and detailed measurements of the dependence of the electrical resistance on temperature and magnetic field have been tabulated.

1604

WORLD-WIDE DISTRIBUTION OF NATURAL RADIOCARBON. E. C. Anderson and W. F. Libby. Phys. Rev. 81, 64-69(1951) Jan. 1.

The natural radiocarbon contents of biological materials collected from locations widely scattered over the earth's surface have shown no evidence of the latitudinal variation which would be expected were the turnover time for the biosphere comparable with the mean life of radiocarbon. The strong dependence of the intensity of the cosmic-ray neutrons, which produce the natural radiocarbon, on latitude would be expected to cause this effect. Since it is expected, however, on geochemical evidence that the turnover time for the biosphere would be very short compared to the mean life of radiocarbon, the observed uniformity is not surprising. The observed mean assay of carbon in equilibrium with the biosphere is 16.1. ± 0.5 disintegrations per minute per gram of carbon. A calculation based on the amount of carbon in equilibrium with the biosphere, and on the cosmic-ray neutron intensity responsible for the production of radiocarbon, gives 18.8 ± 5 dpm/g. However, owing to uncertainties in the knowledge of the foregoing values, the agreement may be fortuitous.

ISOTOPES SEPARATION

1605

ISOTOPE ENRICHMENT THROUGH EXCHANGE REACTIONS. Klaus Clusius. Chimia (Switz.) 4, 275-84 (1950) Dec. 15. (In German)

An outline is made of the theory and of the realization of isotope enrichments by the method of chemical exchange reactions. The concept of zero-point energy, introduced on quantum-mechanical grounds, leads to modifications in the classical curves of the temperature dependence of chemical-equilibria constants and to a redistribution of isotopes according to a "separation factor." The pioneer works of Urey and his collaborators ("open" systems of columns) and several developments devised in Germany are described, such as the use of "closed" systems by Clusius et al. (Z. Naturforsch. 3a, 611(1948) and the introduction of systems of columns working at different temperatures by Harteck and Suess (in Groth, Z. Elektrochem. 54, 5(1950)).

MASS SPECTROGRAPHY

1606

ION OPTICS OF THE ION SOURCE OF MASS SPECTROMETERS. René Vauthier. Compt. rend. 231, 764-5(1950) Oct. 16. (In French)

The system of slits constituting the ion source usually employed in a mass spectrometer may be considered, from the point of view of electron or ion optics, as a system of cylindrical immersion lenses. The ion trajectories, divergence of the ion beam, and beam transport intensities have been calculated for a two-slit system for which the following simplifications have been made: (1) the slits are of infinite length and are in an infinitely thin screen, (2) the thickness of the ionizing electron region is negligible, (3) the ions formed in this region have zero initial energy, (4) the space charge is neglected, and (5) the magnetic field in the interior of the ion source is zero.

1607

ION OPTICS OF THE ION SOURCE OF MASS SPECTROMETERS. René Vauthier. Compt. rend. 231, 1218-20(1950) Nov. 27. (In French)

Calculations on the divergence of the emerging ion beam and the beam transport intensities have been continued (Vauthier, Compt. rend. 231, 764-5(1950)), consideration being taken of the influence of the extraction field and the thickness of the ion source.

MATHEMATICS

1608

NUMERICAL DETERMINATION OF FUNDAMENTAL MODES. Donald A. Flanders and George Shortley. J. Applied Phys. 21, 1326-32(1950) Dec.

A convenient and practical method of numerical determination of the fundamental eigenfunction and eigenvalue in a class of linear eigenvalue problems has been developed and applied in two and three dimensions. The method is based on use of a network and of difference equations, but departs from previous methods in that it is not iterative. Rather, a polynomial operator is applied to a trial function just once, to accomplish a determinable degree of reduction in all eigenfunctions other than the fundamental that are contained in the trial function. In the case of the diffusion equation, the polynomial operator is a Tschebyscheff polynomial of a simple averaging operator. It is shown that this operator, when of degree m, is "better" than any other polynomial operator of this degree and much "better" than m iterations of a simple averaging operator—"better" in the sense of accomplishing to a greater degree the elimination of all unwanted eigenfunctions. Techniques for the use of computing equipment for application of the polynomial operator are discussed. By orthogonalization, the method can be applied to modes other than the fundamental. (auth)

1609

ON THE CHOICE OF NUMERICAL INTEGRATION FORMULAS IN THE SOLUTION OF THE INTEGRO-DIFFERENTIAL EQUATIONS OF TRANSFER (RADIATION, NEUTRONS) BY THE "METHOD OF DISCRETE ORDINATES." V. Kourganoff and C. Pecker. Ann. Astrophys. 12, 247-63(1949) Oct.-Dec. (In French)

An abstract of this paper appeared in Science Abstracts 53A, 539-60(1950) July and is reproduced here in its entirety.

The method of Gaussian subdivisions and characteristic roots used by Chandrasekhar in his treatment of radioactive equilibrium is not necessarily the most effective one. Calculations of the 1st to the 4th approximations in the "standard problem" of isotropic diffusion in a plane-parallel atmosphere are made using the Newton-Cotes and Tchebycheff formulas, and the former is found to give more accurate results in the 2nd and 4th approximations than are obtained by Chandrasekhar. This result is explained by discussing the distribution of the Gaussian subdivisions.

MEASURING INSTRUMENTS AND TECHNIQUES

1610

ABNORMAL EFFICIENCIES IN THE SCINTILLATION-COUNTING OF GAMMA RAYS. E. H. Belcher, Nature 166, 742-3(1950) Oct. 28. (Letter to the editor)

Under conditions of high gain and low pulse discrimination the counting rates for scintillations observed in small thallium-activated KI crystals irradiated by γ radiation may be many times as large as the rates calculated from the Klein-Nishina, Fowler-Hulme, and Heitler theories. The ratio of observed to calculated rates increases with increases in γ-ray energy. It has been shown that this effect is due to electron-trapping levels in the luminophor lattice; each γ-quantum absorbed may thus produce a delayed phosphorescent emission consisting of single photons, in addition to a short-duration fluorescent pulse containing many photons. The number of phosphorescent centers excited by a single γ quantum has been shown to be linearly proportional to the energy of its secondary electron. Studies on the effect of scaler resolving time on counting-rate in thallium-activated KI show that the phosphorescent emission obeys a nonexponential decay law; it falls to half its initial value in 2.5 msec, but persists for many minutes after the initial excitation event. Further observations on synthetic calcium tungstate indicate that this material also shows an impurity-activated phosphorescent emission, but of low intensity and of short duration. Samples of purified anthracene and of anthracene-activated naphthalene have also been examined, but no phosphorescent emission has been detected in the samples tested. (auth)

1611

Commissariat à l'Energie Atomique
CONSTRUCTION AND USE OF SMALL CHAMBERS FOR BORON TRIFLUORIDE. R. Caillat, C. Lallemant, and G. Valladas. 1949. 31p. (CEA-29)

Fabrication of the chamber, material utilized, fabrication of the parts, assembly, testing, preparation of crude boron fluoride, storing of the crude, purification of BF_3 by sublimation and condensation, evacuating, heating, and filling the chamber, and finishing and sealing are described.

1612

CONTINUOUSLY SENSITIVE DIFFUSION CLOUD CHAMBERS. Nucleonics 8, No. 2, 82-3(1951) Feb.

After more than a decade of inactivity, interest has been revived in diffusion cloud chambers which allow continuous observation of the tracks of an ionizing particle. A diagram of the basic cloud chamber is given. The temperature gradient between the room-temperature top and dry-ice-cooled bottom creates partial pressures which cause the methanol vaporizing from the sponge rubber to diffuse toward the bottom of the chamber. At some point between the two surfaces the vapor is cooled sufficiently to produce supersaturation, a required condition if the vapor is to condense on particle tracks. A light shining through the cylinder illuminates the tracks. Advantages and disadvantages are indicated.

1613

CONTRIBUTION TO THE METHODS OF MEASUREMENT OF SCATTERING IN THE PHOTOGRAPHIC PLATE. R. Levi Setti. Bull. centre phys. nucl. univ. libre Bruxelles, No. 22, 1-11(1950) Nov.

The two methods employed for the measurement of multiple scattering in the photographic plate are the angular and the sagittal methods. The results obtained by each of these is subject to errors of two kinds. One, the statistical error, is due to the limited number of measurements obtainable on a track of finite length. The other arises from the uncertainty of the individual measurements of angles or sagittae, due to mechanical imperfections of the measuring instrument, to the random distribution of the developed grains around the path of the particle, and to the personal error of the observer making the measurements. The second error superimposes on the true scattering an additional apparent scattering or noise-level. The purpose of this work is to show how, from the analysis of the results of the noise-level measurements carried out by the two methods and in different instrumental conditions, it is possible to define the limits of energy between which the two methods can give useful information and to determine the accuracy obtainable within these limits. Corrections are also described that make possible the elimination of systematic errors. The reasons why one or another of the methods may be preferable are discussed with respect to the energies that must be measured and the accuracy and speed of the measurements.

1614

CRYSTALS FOR THE SCINTILLATION GEIGER COUNTER. H. O. Albrecht and C. E. Mandeville. Phys. Rev. 81, 163(1951) Jan. 1. (Letter to the editor)

Continuing a discussion of the detection in photosensitive Geiger counters of short-lived fluorescent pulses of ultraviolet light from phosphors irradiated by nuclear particles (Mandeville et al., Phys. Rev. 79, 1010(1950); 80, 117, 299, 300(1950)), a further list of inorganic and organic ultraviolet scintillators is given. Fluorite appears to be the most promixing α, β, and γ detector of that kind; although the activator is unknown, traces of a heavy metal are certainly present. In suggesting the use of photomultipliers with ultraviolet scintillators, it is pointed out that peaking the photocathode in the ultraviolet would reduce the tube's thermionic background.

1615

DESIGN CHARACTERISTICS OF AIR PROPORTIONAL COUNTERS. Addison C. Sheckler. Nucleonics 8, No. 1, 44-9(1951) Jan.

An optimum design was determined by using a variable-dimension counter and by studying flux distributions. Use of proportional counters for β-γ work is considered. (auth)

1616

DETECTION OF X RAYS BY MEANS OF NaI(Tl) SCINTILLATION COUNTERS. H. I. West, Jr., W. E.

Meyerhof, and R. Hofstadter. Phys. Rev. 81, 141-2(1951) Jan. 1. (Letter to the editor)

Using NaI(Tl) crystals (Hofstadter and McIntyre, Nucleonics 7, 32(1950)) with uncooled RCA 5819 photomultiplier tubes, individual x-ray quanta in the energy range 5 to 80 kev were detected with an efficiency approaching 100%, while 2-kev x rays were recorded with an efficiency 50 to 80%. Tests were also made with 411-kev γ rays (from Au^{198}). The efficiencies were derived from the widths of the pulse-height distribution curves. The average pulse height varied linearly with the radiation energy in the range 2 to 411 kev.

1617

GEOMETRICAL EFFICIENCY OF END-WINDOW G-M COUNTERS. G. B. Cook, J. F. Duncan, and M. A. Hewitt. Nucleonics 8, No. 1, 24-7(1951) Jan.

To achieve 95% efficiency in end-window counting, the sample diameter should be less than half that of the window and the sample should be either very close or very far from the window. Corrections must be made if these conditions are not followed or if more valid results are desired. Required data are developed on the basis of the theory presented. (auth)

1618

HIGH-ENERGY NEUTRON THRESHOLD DETECTORS. Bernard L. Cohen. Nucleonics 8, No. 2, 29-33, 45(1951) Feb.

Energy-dependent neutron effects are often more easily studied if threshold detectors are used to define the energy range of detection. Practical application data on choice of detector, analysis procedures, and specific uses are compiled. 11 references. (auth)

1619

LATENT IMAGE FADING IN NUCLEAR EMULSIONS. Arthur Beiser. Phys. Rev. 81, 153(1951) Jan. 1. (Letter to the editor)

The fading of the latent image in nuclear emulsions is probably due to oxidation of silver specks by air and water vapor during storage. Using physico-chemical relations governing gas-solid reaction velocities and adsorption phenomena, the following formulas are derived which give the magnitude of the fading as a function of the pre-development time, air humidity, and temperature: $(D_o - D)/D_o = 1 - \exp(-ct)$, with $c = k_1 H^{1/2} \exp(-k_2/T)$; D_o and D are, respectively, developed-image densities immediately after irradiation and after a storage time t, H is absolute humidity, T absolute temperature, and k_1 and k_2 constants.

1620

LINE NOISE INTERFERENCE WITH PARTICLE COUNTING. C. G. Goss and F. M. Glass. Nucleonics 8, No. 2, 66-9(1951) Feb.

Accuracy of low-level counting often is impaired by oscillatory power-line transients. A study of these disturbances shows that they can be reduced but not eliminated. A simple line-noise monitor aids selection of valid counting periods. (auth)

1621

NEW TYPE COUNTING-RATE RECORDER. H. O. Anger. Nucleonics 8, No. 2, 76-9(1951) Feb.

A standard scaler and recording millivoltmeter were modified to form an instrument that plots points directly proportional to arithmetic mean of count during fixed intervals. (auth)

1622

PROPORTIONAL COUNTERS. III. Serge A. Korff. Nucleonics 8, No. 1, 38-43(1951) Jan. (See also NSA 4-4035)

Electronic circuits designed for use with proportional counters must meet certain limitations imposed by the pulse characteristics of the counters. The required circuits are discussed.

1623

RESPONSE PROBABILITY OF AN ANTHRACENE SCINTILLATION COUNTER OF ELECTRONS. O. Huber, F. Humbel, H. Schneider, and W. Zünti. Helv. Phys. Acta 23, 855-7 (1950) Dec. 10. (Note; in German)

The use of an anthracene scintillation counter in β-β coincidence measurements was found to be convenient. In order to obtain absolute values, the response probability ϵ (Hρ) of the crystal counter must be determined. This was done by measuring the β spectrum of Co^{60} in a lens spectrometer, first with the aid of a thin-window ordinary counter, then with the scintillation device. Even in the case of soft electrons the latter exhibited high response probabilities.

1624

A SLIDE RULE FOR NUCLEAR EMULSION CALCULATIONS. Arthur Beiser. Rev. Sci. Instruments 21, 933-4(1950) Nov. (Laboratory and shop note)

Particle identifications and energy measurements from tracks in nuclear emulsions are generally made on the basis of grain counts and track ranges in the emulsion. Range-energy, range-grain density, and distance from end of track-grain-count calibrations curve are generally made for the various particles recorded in a particular emulsion from identified reference tracks and from theoretical considerations; these curves are then used in subsequent work with the emulsion. When the curves are plotted on logarithmic graph paper, they appear as virtually straight lines, with the curves for the different particles being parallel on each graph. This property has been used to construct a slide rule that, with very little error in most cases, may greatly facilitate work with nuclear emulsions.

1625

TWO BETA-GAMMA-COUNTERS FOR GAS SAMPLES. Rodman Jenkins. Rev. Sci. Instruments 21, 940(1950) Nov. (Laboratory and shop note)

In connection with a study of diffusion in turbulent flow, Geiger counters of two different types were prepared for the determination of activity of a series of gas samples. In all cases the radiation originated in iodoform containing substantial quantities of I^{131}. This isotope emits several γ rays and a β-ray spectrum with a maximum energy of 0.67×10^6 ev. The conditions of the experiment made it desirable to record a large fraction of the disintegrations available. The volume of air in any given sample was restricted to a maximum of about 150 cc. It was necessary to achieve a reproducible relationship between the quantity of I^{131} and the observed counting rate. Satisfactory plateau curves were necessary to allow a succession of analyses to be made without repetition of calibrations. A reasonable compromise between these requirements was found in two designs which are described.

MESONS

1626

ABSOLUTE SELECTION RULES FOR MESON DECAY. D. C. Peaslee. Helv. Phys. Acta 23, 845-54(1950) Dec. 10.

The spontaneous decay of a meson or of a general system of any sort has been examined to determine the complete set of selection rules that do not depend on specific assumptions concerning the matrix elements involved. These rules are independent of the charge, mass, intrinsic spin, and parity of the particles involved, except as otherwise stated. They apply, of course, to any intermediate state as well as to the final state of the system. In particular, the rules are: (1) two-photon decay is prohibited if $J = 1$; (2) two-photon decay is prohibited if J is odd and P is odd; (3) two-photon decay is of parallel or perpendicular polarization as $P(-1)^J = \pm 1$; (4) decay into two spin-0 particles requires $P(-1)^J = P_a P_b$; if they are identical, $P = (-1)^J = +1$; (5) decay into a photon and a spin-0 particle is prohibited for $J = 0$; (6) all other decay processes are allowed, provided that there is an even total number of half-odd spins in the initial and final states. Any other selection rules are relative, not absolute, and depend on detailed assumptions concerning the unobserved intermediate states. (auth)

1627

ON THE PRODUCTION OF NUCLEAR MESONS OF ZERO SPIN BY PHOTONS. Pierrette Benoist-Gueutal, Jacques Prentki, and Jean Ratier. J. phys. radium 11, 553-63 (1950) Oct. (In French)

The production of π mesons of zero spin by high-energy photons has been studied by the method of Feynman with the Born approximation and considering nucleon recoil, but without radiative corrections. In the two possible cases of scalar or pseudoscalar interactions the cross sections depend only on a single interaction constant. The relation of the number of positive and negative mesons produced to the calculated differential and total cross sections and to experimental results with the Berkeley cyclotron are discussed.

1628

PRODUCTION OF LOW-ENERGY π MESONS DURING NUCLEAR COLLISIONS. N. Dallaporta and M. Merlin. Nuovo cimento (9) 7, 963-6(1950) Nov. 20. (Letter to the editor; in Italian)

In recent photoemulsion experiments at high altitudes by Camerini et al. (Phil. Mag. 41, 413(1950)) the following parts of the energy spectrum of π mesons generated in nuclear collisions have been obtained: (1) a curve in the energy range 100 to 1400 Mev, (2) an isolated point corresponding to the low value 1.6 Mev which was determined by using secondary stars produced by σ mesons. It is shown that the gap between the two parts of the spectrum can be filled by using some data reported by Camerini et al. in an earlier work on σ mesons (Nature 162, 433(1948)).

1629

THE RATIO OF ELECTRONS TO MESONS 1100 FEET UNDERGROUND. C. A. Randall and W. E. Hazen. Phys. Rev. 81, 144-5(1951) Jan. 1. (Letter to the editor)

Experiments by Barnothy et al. (Phys. Rev. 74, 1300(1948)) apparently contradict the usual assumption that cosmic-ray energy is carried underground primarily by μ mesons. The present observations, designed to test the issue, were made on a radiation emerging from a salt layer 150 cm thick in a salt mine at a depth of 8.5×10^4 g/cm^2. Coincidences between trays of Geiger counters were measured, and the meson flux subtracted from the total flux in order to obtain the flux of electrons. Since the meson energy spectrum underground is probably a function of zenith angle, the angular distribution of meson intensity for angles near the vertical was obtained, and a comparison made between intensities of electrons and mesons. Although the measured number of electrons is somewhat less than predicted, it is concluded that the uncertainty in the local meson spectrum accounts for the discrepancy and that there is no reason to believe that the penetrating component does not consist mostly of μ mesons.

MOLECULAR STRUCTURE

1630

THE INFRARED SPECTRUM AND STRUCTURE OF TUNGSTEN CARBONYL. Raymond K. Sheline. J. Am. Chem. Soc. 72, 5761-2(1950) Dec. (Note)

In order to determine whether the infrared spectrum agrees with the inferred octahedral structure, and to determine the nature of the C – O bonds, the spectrum of solid $W(CO)_6$ was taken in the region 2 to 15 μ. A simple spectrum which showed a single absorption band at 1997 cm^{-1} was obtained. This is attributed to the unresolved double band of C–O stretching. Comparison with the stretching frequencies and interatomic distances of carbon monoxide, aldehydes, and ketones lead to the conclusion that in the monometallic carbonyls a slightly modified carbon monoxide is coordinately bonded to a central metal atom.

NEUTRONS

1631

THE ANGULAR DISTRIBUTION OF THE D-D NEUTRONS. Ingemar Bartholdson. Arkiv Fysik 2, No. 3, 271-5(1950).

The degree of anisotropy in the angular distribution of neutrons emitted from the D(d,n) reaction for deuteron energies below 0.5 Mev has been investigated. Neutron yield from a heavy-ice target as a function of deuteron energy was measured between 0 and 90 deg to the incident beam and for deuteron energies between 50 and 200 kev. The results are in accordance with the corresponding proton measurements (Konopinski and Teller, Phys. Rev. 73, 822(1948)). This agreement indicates that, in the low deuteron-energy range, the neutron angular anisotropy is mainly dependent on the Coulomb and centrifugal barriers of the incident particle.

1632

Imperial Chemical Industries, Ltd.
EMISSION OF NEUTRONS FROM MOVING FISSION FRAGMENTS. II. POSSIBLE DEDUCTIONS CONCERNING THE EMISSION PROCESS BASED UPON THE OBSERVED ENERGY SPECTRUM OF SECONDARY NEUTRONS. N. Feather. Oct. 20, 1942. Decl. Apr. 1, 1949. 5p. (BR-336A; BDDA-194)

The possibility of testing assumptions of isotropy in center-of-gravity system and unique energy in equation of energy spectrum of secondary neutrons of fission, if only one type of fragment nucleus is involved, is considered. Calculations of the significance of such treatment in the actual cases of many types of fragment nuclei are made.

1633

NEUTRON SPECTRA FROM NUCLEAR REACTIONS INDUCED BY 16-MEV PROTONS. P. C. Gugelot. Phys. Rev. 81, 51-60(1951) Jan. 1.

The form of neutron spectra from (p,n) reactions has been studied by measuring proton recoil tracks in photographic emulsions which were exposed to neutrons produced by bombardment of 1-Mev thick targets of several elements with 16-Mev protons. The number of emitted neutrons with energy ϵ can be represented by $nd\epsilon = \text{const}\ \epsilon \times \exp(-\epsilon/T)d\epsilon$ for $\epsilon > 2$ Mev. The values of T for different elements are found to be as follows: Be: T = 2.3 ± 0.3 Mev (for $\epsilon > 4$ Mev), and T = 0.9 ± 0.1 Mev (for $1 < \epsilon < 4$ Mev); Al: T = 1.3 ± 0.1 Mev; Fe: T = 0.95 ± 0.1 Mev; Rh: T = 0.85 ± 0.1 Mev; Au: T = 0.8 ± 0.1 Mev; Tl: T = 0.78 ± 0.1 Mev. From these results the relative level density for the residual nucleus is calculated and compared with other experimental data and with theoretical predictions. The experimental values for T are lower than those predicted by Weisskopf's statistical model. (auth)

NUCLEAR PHYSICS

1634

University of California Radiation Laboratory
PHYSICS DIVISION QUARTERLY REPORT; MAY, JUNE, AND JULY, 1950. Sept. 6, 1950. 41p. (UCRL-896)

Cloud Chamber Program. The differential energy spectrum of the photons produced by 322-Mev electrons striking a 20-mil platinum target was measured by observing the energy of 3467 pairs produced in a lead foil in a Wilson cloud chamber. (See also UCRL-660)

Film Program. Studies of nuclear interaction of π^- mesons, high-energy protons from π^- stars, stars produced by high-energy protons in nuclear emulsions, meson focusing, electron-electron and electron-nuclear scattering, grain density of an emulsion, meson mass measurements, kinetic energy of a μ meson, design of a magnetic field to hold together a beam of mesons from external targets, etc., are reported.

The Particle Spectrometer. Results of n-d scattering experiments using the 270-Mev neutron beam from the 184-in. cyclotron are reported.

Scintillation Counters. Operation of photomultipliers under pulsed conditions is reported. Equipment employed in generating the high voltage pulses consists of an adjustable rectangular pulse generator (triggered by an advance pulse from the accelerator circuits) which drives a high-voltage keying unit. A method is discussed for getting all of the resolution possible from scintillation pulses by using an oscilloscope as the mixing element.

Heavy Ion Acceleration in the 60-in. Cyclotron. Results of Al and Au bombardment with C^{12} and C^{13} are reported. High cross sections were indicated for the reactions.

Charged Particle Emission from Pb after Bombardment with α Particles. Half-lives of 0.6 sec, 30 sec, and 3 min resulted when Pb was bombarded with α particles.

Proton-Proton Scattering. Measurements made with the 345-Mev cyclotron indicate the differential scattering cross section to be 4×10^{-27} cm^2 sterad^{-1} (center-of-mass system system).

Stopping Power and Energy for Ion Pair Production for 340-Mev Protons. The relative stopping powers for 300-Mev protons of H, Li, Be, C, Al, Fe, Cu, Ag, Sn, W, Pb, and U have been measured. The energy spent per ion-pair production in the gases H_2, He, N_2, O_2, and A at 340-Mev proton energy were also measured. All results are tabulated. (See also UCRL-850)

Capture of Negative π Mesons in Hydrogen. Results of putting an improved γ-ray pair spectrometer into operation to improve the resolving power of the capture experiment are indicated by the following: (1) the branching between the process $\pi^- + H = n + \pi^0$ and the process $\pi^- + H = n + \gamma$ is 0.96 ± 0.20; (2) the mass of the neutral π meson as deduced from the Doppler shift of the γ rays from the disintegration of the π^0 is 135 ± 6 electron masses; and (3) the value of the π^- mass deduced from the position of the γ line and also from the central position of the π^0 peak is in excellent agreement with the π^- mass derived from meson range and curvature using photographic plate detectors.

Capture of Negative π Mesons in Deuterium. The experiment outlined in the previous section has been repeated using deuterium as a capture target. Emission of two fast neutrons is indicated as a third process. On the basis of a selection rule it is shown to be impossible that the π^- meson is scalar in the system.

Neutron Proton Scattering at Large Proton Scattering Angles. Work has been completed on the analysis of the large angle protons produced in neutron-proton scattering, in hydrogen, of 90-Mev neutrons.

Meson Beam Production. A meson beam of 5000 mesons per second from a channel 2 by 2.5 in. has been produced by bombardment of polyethylene with 340 Mev-protons.

Brief references to synchrotron studies, scattering experiments, meson theory, shower theory, and accelerator operation and development (184-in. cyclotron, 60-in. cyclotron, synchrotron, linear accelerator and Van de Graaff machines, and bevatron) are made.

1635

CAPILLARITY IN ATOMIC NUCLEI. R. Auerbach. Kolloid-Z. 119, 102-3(1950) Nov. (Note; in German)

Since the introduction of the drop model of the nucleus by Gamow, many hydrodynamic and colloid-chemical concepts have been used for the interpretation of nuclear phenomena. Thus, Steinwedel et al. (Z. Naturforsch. 5a, 413(1950)) have recently postulated vibrations of a proton liquid against a neutron liquid in the nucleus and have calculated the corresponding "sound velocity" as 6×10^7 m/sec. In the present paper, by using formulas of capillary physics, macrophysical and nuclear-physical domains are embraced in one curve exhibiting values differing by factors of 10^5, 10^{15}, and 10^{21} in the sound velocity, density, and surface tension, respectively. By taking into consideration capillary properties introduced by electrostatic charges of protons, changes in the surface tension as a function of the atomic mass are computed. Several other extrapolations lead to a representation of the nuclear substance as an extremely viscous ($10^{50,000}$ poise), hard (25 in Mohs' scale), and solid (elasticity modulus 10^{22} to 10^{25} kg/mm^2) matter that exhibits liquid properties only when confronted with the high specific values of nuclear forces.

1636

INVESTIGATION OF THE PHOTOFISSION OF C^{12} INTO THREE ALPHA PARTICLES. V. L. Telegdi and W. Zünti. Helv. Phys. Acta 23, 745-93(1950) Dec. 10. (In German)

Using 200-μ-thick Ilford E-1 plates irradiated with γ rays from the resonance capture of 440-kev protons by Li^7, the authors have studied the fission of C^{12} into three α particles. At γ-ray energies up to 25 Mev, the stars reveal the presence of the intermediate process (γ,α) yielding Be^{8*}, mainly in the known 3-Mev excited state, but partly in the 8-Mev state. At very high energies the direct fission into three α particles probably takes place. A theoretical evaluation of the results seems to contradict the representation of the C^{12} nucleus as an aggregate of α particles. It is suggested that the photofission of carbon could be used in γ spectroscopy for energy measurements of spectral lines. 43 references.

NUCLEAR PROPERTIES

1637

Argonne National Laboratory
ODD-EVEN EFFECT IN NEUTRON CAPTURE GAMMA RAY SPECTRA. Bernard Hamermesh. Nov. 1, 1950. 4p. (AECU-1035; UAC-323)

Additional evidence has been obtained showing the dependence of the shapes of the neutron capture γ-ray spectra on the odd-even character of the compound nuclei formed after neutron capture. The D_2O-soaked plate method has been applied to two groups of three adjacent elements, Mn, Fe, Co and Ag, Cd, In. The evidence shown indicates that in elements of nearly the same Z the mode of decay from the highly excited state formed on thermal neutron capture is different in nuclei of differing odd-even types. This would indicate a possible dependence of level spacings on odd-even characteristics of nuclei. 2 figures.

1638

BINDING ENERGY OF THE TRITON. Robert L. Pease and Herman Feshbach. Phys. Rev. 81, 142-3(1951) Jan. 1. (Letter to the editor)

Since predictions of high-energy n-p scattering data and of the triton binding energy depend on the assumed shape of the interaction potential, calculations were made of the dependence of the binding energy of H^3 on the range of the tensor force part of such a potential. The assumed expression of the nuclear-interaction potential, consisting of central and tensor terms, had been successfully used by the writers in describing low-energy scatterings and the properties of H^2; it was adapted to the present case by using, instead of scattering data, the experimental value of the binding energy of H^3 to set the range of tensor forces.

1639

COLLISION CROSS SECTIONS OF HYDROGEN AND OF DEUTERIUM. I. Amdur, M. C. Kells, and D. E. Davenport. J. Chem. Phys. 18, 1676-8(1950) Dec.

Total collision cross sections have been measured for hydrogen atoms, with energies between 300 and 800 ev, scattered in room-temperature hydrogen, and for deuterium atoms, with energies between 500 and 1150 ev, scattered in room-temperature deuterium. The H-H_2 cross section has a pronounced maximum at 600 volts indicating the presence of inelastic scattering. In the case of D-D_2 there is a similar effect, less pronounced, at about 800 volts. Classical theory has been used to evaluate the repulsive potentials for the two systems on the assumption that smooth curves through the experimental results represent elastic cross sections, and that the atoms and molecules are mass points whose interaction forces are spherically symmetrical. For H-H_2, the present potential has been combined with one previously obtained, and the results represented by $V(r) = [0.708 \exp(-29.9\ r^2) + 0.0607 \exp(-0.942\ r^2)] \times 10^{-10}$ erg for r between 0.27 and 0.68 A. The relation for D-D_2 is $V(r) = 4.59 \times 10^{-11} \exp(-5.17\ r^2)$ erg for r between 0.29 and 0.56 A. The D-D_2 potential is considerably larger than that for H-H_2 for r between 0.29 and 0.56 A, but the difference decreases markedly as r increases. It is suggested that the apparent difference in the potentials may result from the assumption of spherical symmetry which, even on a relative basis, does not exist in the present case because of the difference in the nuclear statistics of H_2 and D_2. (auth)

1640

THE DIAMAGNETIC CORRECTION FOR PROTONS IN WATER AND MINERAL OIL. H. A. Thomas. Phys. Rev. 80, 901-2(1950) Dec. 1. (Letter to the editor)

The proton nuclear resonance shifts between H_2 gas and water, mineral oil, and the standard sample used in the determination of the proton gyromagnetic ratio (Thomas, Driscoll, and Hipple, Phys. Rev. 78, 787(1950)) have been measured. The actual shifts from H_2 gas for oil and water are, respectively: $\Delta H/H = +1.6 \times 10^{-6}$ and $\Delta H/H = -0.6 \times 10^{-6}$. Combining these shifts with the diamagnetic correction for H_2 gas calculated by Ramsey (Phys. Rev. 78, 699(1950); NSA 4-5014), the diamagnetic corrections for mineral oil and water are, respectively, $\delta_{oil} = 28.4 \times 10^{-6}$, and $\delta_{H_2O} = 26.2 \times 10^{-6}$.

1641

THE ELECTRIC QUADRUPOLE MOMENT OF Li^6. N. A. Schuster and G. E. Pake. Phys. Rev. 81, 157-8(1951) Jan. 1. (Letter to the editor)

Using a recording radio-frequency spectrometer, quadrupole splitting of the Li^6 and Li^7 magnetic resonances was obtained from a natural single crystal of spodumene $LiAl(SiO_3)_2$. With a constant magnetic induction of about 7312 gauss, the Li^7 resonance occurred near 12.10 mc/sec, while that of Li^6, which was presumably present in its natural abundance, fell near 4.58 mc/sec. The centers of the satellite lines of the Li^7 resonance were found to be separated by $\Delta\nu_7 = 66.4 \pm 0.6$ kc/sec; the corresponding value for Li^6 was $\Delta\nu_6 = 2.30 \pm 0.15$ kc/sec. Using the formula for the ratio of quadrupole moments $\left|Q_6/Q_7\right| = \Delta\nu_6 I_6/\Delta\nu_7 I_7$ (where I_6 and I_7 are nuclear spins known to be 1 and $\frac{3}{2}$, respectively), it was found $\left|Q_6/Q_7\right| = (2.3 \pm 0.2) \times 10^{-2}$.

1642

THE ISOTOPIC WEIGHT OF HELIUM. Kenneth T. Bainbridge. Phys. Rev. 81, 146-7(1951) Jan. 1. (Letter to the editor)

A table of isotopic weights obtained by the combination of nuclear reaction Q values and mass spectrograph doublets has been published by Tollestrup et al. (Phys. Rev. 78, 372(1950)). It is shown here (1) that a more satisfactory isotopic weight scale can be based on a different approach, in which the value for He^4 is obtained from the mass spectrographic ($2D^2 - He^4$) doublet, and (2) that apparent gross errors which exist in the Q values can reasonably be attributed to the values associated with the $Li^7(p,\alpha)He^4$ and $Li^6(d,\alpha)He^4$ reactions.

1643

MASSES OF FUNDAMENTAL PARTICLES. R. Fürth. Nature 166, 727-8(1950) Oct. 28.

Values of the proton-electron mass ratio and the masses of π and μ mesons which agree closely with observed values are derived in terms of pure numbers without the introduction of arbitrary constants from the following propositions: (1) The fundamental length or "radius" to be associated with a neutral particle of rest mass m_0 is its Compton wavelength, h/m_0c. (2) For a particle of zero rest mass (photon) the corresponding length is equal to the wavelength $\lambda = c/\nu$. (3) The 'radius' of a charged particle of rest mass m_0 is equal to ke^2/m_0c^2 with $k = 15/32$. (4) The radius of a neutral nucleon is identical with the range of its nuclear field. (5) In a process of transmutation of fundamental particles, the radii of the primary and secondary particles satisfy the equation $\sum_i \delta_i r_i = 0$ with $\left|\delta_i\right| = 1$. The electronic-mass numbers of two possible neutrettos are calculated to be 701 and 1135, but the possibility of these particles having a continuous mass spectrum is considered.

1644

MASSES OF FUNDAMENTAL PARTICLES. G. Stephenson. Nature 166, 655-6(1950) Oct. 14. (Letter to the editor)

From an equation of Wentzel's relating the rest mass of a field-free particle to its mass in an electromagnetic field the equation $M_2(M_1 - M_2) = K(137/2)^2$ relating the masses of pairs of fundamental particles is derived. For neutron and proton, $K = 1$; for π and μ mesons, $K = 3$, giving excellent agreement with experiment. The author finds it reasonable to assume that the heavy τ meson (mass approximately 810 electrons) will be described by $K = 2$, and the neutrino by $K = 4$, and to pair the neutrino with the theoretical heaviest possible atom, calculated to have $Z = 137$ and $A = 380$ ($\approx$700,000 electron masses). Substituting this value for M_1 in the foregoing equation, the neutrino mass is found to be 0.0268 electron mass. The M_2 (lighter) masses are related to this value by the formula $M_m^{1/2} - M_\nu^{1/2} = n\sqrt{64\pi\beta}\, m^{1/2}$ where $n = 1$, 2, and 3 for μ meson, τ meson, and proton, respectively; m is the electron mass; and β is the Bond factor 137/136. It is suggested that this relation expresses a new physical concept.

1645

M.I.T. Research Laboratory of Electronics
A NEW "DOUBLE RESONANCE" METHOD FOR THE INVESTIGATION OF ATOMIC AND NUCLEAR MOMENTS; PART I. THEORY OF EFFECTS IN MERCURY VAPOR. (Technical Report No. 176). F. Bitter and J. Brossel. Sept. 12, 1950. 24p. (NP-1924)

The "double resonance" method is an outcome of several previously published ideas. In general, if a system is capable of existing in three states, A, B, and C, the method involves the detection of resonances between any two of these, say A and B, by observing changes in transitions from either A or B to C. Of particular interest is the case in which A and B are either Zeeman or hyperfine structure levels, and transitions to C involve frequencies in the optical range. Effects to be expected are analyzed with particular emphasis on mercury vapor. Measurements on both the ground and excited states should be possible. (auth)

1646

A NOTE CONCERNING THE $C^{14} - N^{14}$ β-DECAY. E. Gerjuoy. Phys. Rev. 81, 62-3(1951) Jan. 1.

The possibility that the parities of the ground states of C^{14} and N^{14} are opposite is discussed. Experiments which would determine or assist in determining the parity change are suggested. (auth)

1647

M.I.T. Laboratory for Nuclear Science and Engineering NUCLEAR CROSS SECTIONS GROUP, p. 91-130 of [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950.] W. W. Buechner. July 1, 1950. 40p. (NP-1777(p. 91-130))

A number of changes and improvements made in equipment and techniques are described. Rather detailed reports of experimental results on the energy levels of Be^{7}, Be^{9}, B^{11}, B^{12}, C^{12}, C^{13}, C^{14}, N^{13}, N^{14}, N^{15}, N^{16}, O^{16}, F^{20}, Al^{28}, and Mg^{25} are given. Measurements on a large number of ground-state transition energies are tabulated.

1648

NUCLEAR MAGNETIC RESONANCE IN METHANE. J. T. Thomas, N. L. Alpert, and H. C. Torrey. J. Chem. Phys. 18, 1511(1950) Nov. (Letter to the editor)

Graphs of the thermal relaxation time (T_1) and of the line width versus absolute temperature are given. The data were obtained by a pulse method using a new nuclear resonance cryostat accurate to within 0.1°K near 20°K and to 0.2°K near 80°K. The line-width data do not agree with those previously reported. The absence of any change in line width at the λ-point at 20.4°K eliminates the possibility of a rotational transformation. The data for T_1 are more complex. The values reported are reproducible to about 1% above 65°K and to about 5% below 65°K where the line becomes broad. The salient features are as follows: (1) The value of T_1 in the vicinity of 2 to 4°K is extremely small. (2) The behavior of T_1 is anomalous in the vicinity of the λ-point, and there may be a small discontinuity in T_1 near the λ-point. (3) There are two dips in T_1 in the solid state rather than one. (4) T_1 is continuous across the melting point. (5) The small dip in T_1 just above the melting point is unexpected on the basis of existing theories. The possibility of paramagnetic impurity is considered, and explanations of some of the effects are proposed.

1649

NUCLEAR SPIN RELAXATION TIMES IN SINGLE CRYSTALS OF LiF. R. V. Pound. Phys. Rev. 81, 156(1951) Jan. 1. (Letter to the editor)

Although the relaxation times of nuclear spins in crystals are usually of the order of seconds or fractions of a second at room temperatures, the author had observed in $LiNO_3$ a relaxation time of the order of an hour (Phys. Rev. 79, 685(1950)). In experiments reported here single crystals of LiF were used. Whereas in one of them the relaxation times were found to be 5 min for Li^{7} and 2 min for F^{19}, in another, apparently magnetically less pure, the corresponding values were 2 min and 45 sec. The reduction of the relaxation time through the action of x rays, and the effects of x-ray-produced color centers were also studied.

1650

ON THE EXISTENCE OF A ONE-MEV ENERGY LEVEL IN C^{13}. Mary Blundell and J. Rotblat. Phys. Rev. 81, 144(1951) Jan. 1. (Letter to the editor)

There has been considerable discussion, recently, concerning the existence of an energy state of C^{13} at 0.8 to 1.0 Mev. A detailed search for this level was made, in the course of a study of energy states of C^{13}, by irradiating acetylene with 8-Mev deuterons and measuring the energy of the emitted protons by means of photographic emulsions. Although large areas of the plates were scanned and several angles of emission studied, no trace of a C^{13} level between the ground state and the 3.11-Mev excited state was found. The observation of such level by other workers can possibly be explained as due to oxygen contamination, viz., to the presence of protons corresponding to the 0.88-Mev excited state of O^{17} from the reaction $O^{16}(d,p)$.

1651

ON THE NUCLEAR MAGNETIC MOMENTS OF SEVERAL STABLE ISOTOPES. W. G. Proctor and F. C. Yu. Phys. Rev. 81, 20-30(1950) Jan. 1.

Results of studies of 18 nuclei with a nuclear induction spectrometer are given. Nuclear resonance frequencies have been found to depend upon the compound used for the sample in some cases. This has been noted for the isotopes of Cl and N, and for Co, the latter having resonances over a region as large as 1.3%. This effect has been demonstrated to be of molecular rather than nuclear origin, and it is responsible for our listing the chemical compounds used for each measurement. The magnetic moments of both In^{113} and In^{115} have been found to be 0.64% greater than their respective atomic-beam values, a discrepancy very similar to that noted for Ga^{69} and Ga^{71}. A hyperfine structure anomaly for the isotopes of chlorine has been observed, which is notable, because the atomic-beam experiments deal with the $P_{\frac{3}{2}}$ state of atomic chlorine. An unusual structure for the Sb^{121} and Sb^{123} resonances in aqueous solution of $NaSbF_6$ has been observed and is qualitatively explained.

1652

ON THE QUANTIZATION OF ANGULAR MOMENTA IN HEAVY NUCLEI. Aage Bohr. Phys. Rev. 81, 134-8(1951) Jan. 1.

The individual-particle model of nuclear structure fails to account for the observed large nuclear quadrupole moments. It is possible, however, to allow for the existence of the quadrupole moments, and still retain the essential features of the individual-particle model, by assuming the average field in which the nucleons move to deviate from spherical symmetry. The assumptions underlying such an asymmetric nuclear model are discussed; this model implies, in particular, a quantization of angular momenta in analogy with molecular structure. The asymmetric model appears to account better than the extreme single-particle model for empirical data regarding nuclear magnetic moments. (auth)

NUCLEAR REACTORS

1653

Atomic Energy Project (Canada)
CRITICAL CONDITIONS FOR A MULTIPLYING SPHERICAL

CORE WITH AN INFINITE REFLECTOR OF THE SAME SCATTERING PROPERTIES. G. M. Volkoff. Jan. 29, 1944. 71p. (CRT-391)

This report is divided into two parts. In part I the physical assumptions underlying the present treatment of the critical conditions in a multiplying spherical core with an infinite reflector are stated, the problem is formulated mathematically, the approximations used are qualitatively discussed, and the formal results are collected together. In part II the mathematical details of the solution of the problem are presented and the approximations used are discussed quantitatively. The method used is a modification of the Hopf-Wiener solution of Milne's integral equation. The formal results of this report have been obtained for a quite general type of slowing-down mechanism and for both multiplying and nonmultiplying reflectors.

1654

GLEEP: DESIGN, CONSTRUCTION, AND USE. F. C. W. Colmer and D. J. Littler. Nucleonics 8, No. 1, 3-11(1951) Jan.

The Gleep (graphite low-energy experimental pile) is a slow-neutron reactor using graphite as a moderator and natural uranium and uranium dioxide as the fissionable material. It has been in operation since August 15, 1947. It meets two main requirements: (1) to run as high a power as possible without elaborate cooling arrangements, and (2) to compare slow-neutron absorption cross sections of the elements by the pile-modulation method. As a later development it was found that Gleep could be used to provide an accurately known and reproducible thermal-neutron flux in the range 10^6 to 10^8 n/cm^2/sec. This flux is used to determine activation cross sections. The present article is the first detailed report on this pile since the recent Declassification Guide was approved by the United States, Canada, and Great Britain.

1655

Atomic Energy Research Establishment
A METHOD OF CALCULATING THE CRITICAL DIMENSIONS OF SPHERICALLY SYMMETRICAL REACTORS; PART I. H. M. Melvin. Oct. 1950. 11p. (AERE-T/R-586; revised version of AERE-T/R-108)

A method is described of calculating the critical dimensions of spherically symmetrical reactors comprising a homogeneous core of fissile matter contained in an infinite homogeneous tamper of scattering and absorbing, but non-multiplicative, materials. The method is based on the one-group model in which all neutrons are assumed to have the same speed. Provided that the various cross sections occurring in the equations for this model can be given the right (average) values, this assumption will not lead to serious errors in the critical radius.

1656

Atomic Energy Research Establishment
A METHOD OF CALCULATING THE CRITICAL DIMENSIONS OF SPHERICALLY SYMMETRICAL REACTORS; PART II. SYSTEMS WITH A FINITE TAMPER. H. M. Melvin. Oct. 1950. 19p. (AERE-T/R-587; revised version of AERE-T/R-171)

The method described in the first report of this series (AERE-T/R-586) is here adapted to the calculation of the critical dimensions of a homogeneous sphere of fissile material embedded in a homogeneous concentric spherical tamper of finite dimensions. The Serber-Wilson method is discussed, an equation determining the critical dimensions is derived, and a graphical method for solving the equation for the critical dimensions is described.

NUCLEAR TRANSFORMATION

1657

ANGULAR DISTRIBUTION OF THE γ RADIATION EMITTED IN THE REACTION $Li^7(p,\gamma)Be^8$, AND THE EXCITED STATES OF Be^8. H. Nabholz, P. Stoll, and H. Wäffler. Helv. Phys. Acta 23, 858-63(1950) Dec. 10. (Note; in German)

Unlike the lower excited states of Be^8, which decay into two α particles, the 17.6-Mev state, obtained through the 438-kev resonance capture of protons by Li^7, emits γ rays of 17.6 and 14.6 Mev. The emission of α particles seems to be forbidden in this case, a situation that requires an odd quantum number J, or an odd parity, or both, of the state in question. The existence of an odd J and an even parity were established from angular distribution measurements by observing an anisotropy of the 14.6-Mev radiation. The measurements consisted both of observations of the global radiation with the aid of counters, and of a further discrimination between the two components by using stars produced in photoemulsions through the process $C^{12}(\gamma,\alpha)2\alpha$.

1658

THE DISINTEGRATION OF THE DEUTERON BY NEUTRON IMPACT. B. H. Bransden and E. H. S. Burhop. Proc. Phys. Soc. (London) 63A, 1337-48(1950) Dec. 1.

The method of distorted waves is applied consistently to the calculation of the cross section for disintegration of deuterons by neutrons. At an incident neutron energy of 11.5 Mev the cross section calculated for the process (6.4×10^{-25} cm^2) is about one-third that obtained in previous calculations but is nevertheless an order of magnitude greater than that indicated by the rather meager experimental data. The calculated cross section is also larger than the maximum permitted by considerations of the conservation laws. This indicates that the n-d interaction is so strong that the requirements for the validity of the distorted wave method are not satisfied. At an incident neutron energy of 5.1 Mev where it is considerably less than the permitted maximum, the calculated cross section is of the same order of magnitude as that deduced indirectly from measurements of the p-d disintegration cross section, allowing for the effects of the electrostatic repulsion between the proton and the deuteron.

1659

THE EMISSION OF SHORT RANGE ALPHA PARTICLES FROM LIGHT ELEMENTS UNDER PROTON BOMBARDMENT. IV. THE REACTION $^{19}F(p\alpha)^{16}O$. Joan M. Freeman. Phil. Mag. (7) 41, 1225-37(1950) Dec.

The short-range α particles emitted in the proton bombardment of F have been examined with a magnetic analyzer for

proton energies from 300 to 950 kev. In the $F^{19}(p\alpha,\gamma)O^{16}$ reaction three α-particle groups have been measured, the average values of the energy releases being $Q_1 = 1.979 \pm 0.009$, $Q_2 = 1.200 \pm 0.010$, and $Q_3 = 0.996 \pm 0.010$ Mev; the resonances for all three groups appear to be the same. The relative intensities of the groups at six resonances have been calculated. Angular distribution measurements indicate that there are no large departures from isotropy in the cases examined. Energy measurements of the α particles associated with pair emission in the $F^{19}(p\alpha,\pi)O^{15}$ reaction give a value for the energy release of 2.056 ± 0.012 Mev. (auth)

1660

THE EMISSION OF SHORT RANGE ALPHA PARTICLES FROM LIGHT ELEMENTS UNDER PROTON BOMBARDMENT. IV. THE REACTION $^{19}F(p\alpha)^{16}O$. Joan M. Freeman. Phil. Mag. (7) 41, 1225-37(1950) Dec.

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1661

THE (p,n) REACTION ON SCANDIUM AND VANADIUM: ENERGY LEVELS OF Ti^{45} AND Cr^{52}. W. D. Baker, J. S. Howell, Clark Goodman, and W. M. Preston. Phys. Rev. 81, 48-50(1951) Jan. 1.

Thin targets of the monoisotopic elements V and Sc were bombarded with magnetically resolved protons at energies up to about 4 Mev. The neutron and gamma-ray yields were measured as functions of the proton energy. In each case a number of maxima are observed in the yield curves, presumably corresponding to excited states in the compound nucleus. (auth)

1662

PRECISE DETERMINATION OF THE $Li^7(p,\alpha)He^4$ AND $Be^9(d,\alpha)Li^7$ Q-VALUES. Ward Whaling and C. W. Li. Phys. Rev. 81, 150-1(1951) Jan. 1. (Letter to the editor)

A mass-spectroscopical determination of the Q value of the reaction $Li^7(p,\alpha)He^4$ was made using thin and thick targets and proton bombarding energies of 1008 and 336 kev. The energy scale of the α spectra was fixed by the peak of the ThC′ α spectrum, and the results obtained were corrected for the thickness of the targets and for the energy loss of incident and emitted particles in the surface layers of C and O that appear on the target surface during the bombardment. The Q value obtained is 17.338 ± 0.011 Mev, the uncertainty arising from various experimental factors, of which the largest, 7.5 kev, is due to the probable error in the determination of the angle between the direction of the proton beam and that of the α particles entering the spectrograph. Following the same procedure, the Q value of the $Be^9(d,\alpha)Li^7$ reaction was found to be 7.151 ± 0.010 Mev. A calculation of the mass of the α particle, based on the Q values found, furnished the value 4.003840 ± 0.000018.

1663

PROTON GROUPS FROM THE DEUTERON BOMBARDMENT OF F^{19} AND P^{31}. Robert C. Allen and Waldo Rall. Phys. Rev. 81, 60-2(1951) Jan. 1.

The $F^{19}(d,p)F^{20}$ and $P^{31}(d,p)P^{32}$ reactions were studied with 3.76-Mev cyclotron deuterons. The $F^{19}(d,p)F^{20}$ ground-state Q value was found to be 4.16 ± 0.08 Mev, giving 1.00211 ± 0.00010 MU for the $F^{20} - F^{19}$ mass difference and 20.00660 ± 0.00012 MU for the mass of F^{20}. Excited states of F^{20} were found at 0.64, 0.97, 1.31, 1.91, 2.52, 2.83, 3.45, and 4.01 Mev. The $P^{31}(d,p)P^{32}$ ground-state Q value was found to be 5.52 ± 0.10 Mev, giving 1.00065 ± 0.00011 MU for the $P^{32} - P^{31}$ mass difference, and 30.98286 ± 0.00021 MU for the mass of P^{31}. Excited states of P^{32} were found at 0.50, 1.10, 1.36, 1.71, 2.22, 2.72, and 3.27 Mev. (auth)

1664

M.I.T. Laboratory for Nuclear Science and Engineering RADIOACTIVITY AND CYCLOTRON GROUP, p. 131-86 of [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950.] R. D. Evans and M. S. Livingston. July 1, 1950. 36p. (NP-1777(p. 131-86))

An apparatus for studying β-γ angular correlations is described briefly, and some work on γ-ray lifetimes, annihilation of fast positrons, and scintillation and proportional-counter spectrometers is summarized. The numerous investigations reported on the emission of heavy charged particles from nuclei bombarded by 14-Mev deuterons include angular distributions of protons, deuterons, and tritons; neutron binding energies from (d,p) reactions; proton reactions; inelastic deuteron and α-particle scattering; (d,α) and (d,p) reactions; the low-energy proton component; and triton emission. Studies on the gas-discharge mechanism of proportional counters also are reported.

1665

REACTION ENERGY $Q_{n,p}$ OF THE PROCESS $N^{14}(n,p)C^{14}$. Peter Meyer. Z. Physik 128, 451-4(1950) Oct. 3. (In German)

The energy $Q_{n,p}$ liberated during the reaction $N^{14}(n,p)C^{14}$ was measured by irradiating with thermal neutrons a proportional counter filled with pure nitrogen. In good agreement with other authors, the value found was $Q_{n,p} = 0.610 \pm 0.01$ Mev. (auth)

PARTICLE ACCELERATORS

1666

M.I.T. Laboratory for Nuclear Science and Engineering AN ELECTRON INJECTION GUN FOR THE M.I.T. SYNCHROTRON; TECHNICAL REPORT NO. 49. Orville L. Stone. Dec. 15, 1950. 63p. (NP-1909)

Since the beam intensity of synchrotrons is known to increase as the energy of electrons at injection is increased, as high voltage as possible is desired on injection guns. In order to attain an injection voltage of more than 100 kv, a three-electrode gun was built. Improved focusing of the injection beam was another objective. A device was built for measuring the distribution of current in the injection beam, and a rubber sheet model was used for studying the focusing problem. Efforts to increase the voltage which could be supported across a given interelectrode space included: mechanical buffing; electrolytic polishing of the stainless steel, molybdenum, and tungsten parts of the gun structure and leads; and rounding of corners and edges of certain areas of the gun structure. The cathode was of sintered thoria-molybdenum, and the shape of its emission surface was an important factor in focusing the injection beam. Other characteristics of the cathode include high emission at relatively low power, no required activation process, and no detrimental effects from exposure to air when cold. The gun held 110 to 115 kv with sparking occurring during less than one per cent of the pulses. One section of the gun held 72 kv and the other 65 kv when voltage was applied to one section only. At a distance of 5 in. from the gun, about 25% of the total emission was within an area of the same length as the cathode and twice the width. 15 references. (auth)

1667

M.I.T. Laboratory for Nuclear Science and Engineering ELEMENTARY PARTICLE SCATTERING GROUP, p. 23-40 of [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950.] J. R. Zacharias. July 1, 1950. 18p. (NP-1777(p. 23-40))

The r-f system, electron injection, beam alignment and focusing, and beam analysis of the linear accelerator are described, and a list of proposed experiments with this machine are given. Work with the 1-Mev Van de Graaff generator, photodisintegration experiments at the synchrotron, nuclear emulsion studies on the energy and angular distribution of mesons from H, D, and C, and α-γ angular correlation measurements are summarized.

1668

M.I.T. Laboratory for Nuclear Science and Engineering 12-MEV GENERATOR CONSTRUCTION AND HIGH-VOLTAGE RESEARCH GROUP, p.41-50 of [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950.] J. G. Trump. July 1, 1950. 10p. (NP-1777(p.41-50))

The construction of the 12-Mev positive-ion accelerator; studies on positive-ion sources, breakdown in compressed gases, and factors affecting acceleration-tube performance; sterilization of foods with high-energy cathode rays; and deep, 2-Mev x-ray therapy using the rotational technique are summarized.

1669

M.I.T. Laboratory for Nuclear Science and Engineering SYNCHROTRON GROUP, p.187-98 of [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950.] I. A. Getting. July 1, 1950. 12p. (NP-1777(p.187-98))

The development of the synchrotron is reviewed briefly, and improvements in the magnet, acceleration tube, and injection gun are described. The successful location of the beam is reported, and the spectrum of continuous radiation from the electron beam is presented.

RADIATION ABSORPTION AND SCATTERING

1670

COHERENT SCATTERING OF LIGHT BY AN ATOM AND NEGATIVE ENERGY STATES. K. J. Le Couteur and S. Zienau. Proc. Phys. Soc. (London) 63A, 1223-26(1950) Nov. 1.

It is proved that the difference between the single-electron theory and the positron theory for the coherent scattering of light by an atom represents the scattering of light by the atomic potential. In the practical cases the effect is negligible. The gauge invariance of the perturbation formulas for this effect is discussed. (auth)

1671

THE CONSERVATION OF ENERGY AND MOMENTUM IN COMPTON SCATTERING. William G. Cross and Norman F. Ramsey. Phys. Rev. 80, 929-36(1950) Dec. 15.

Many experiments were performed in 1936, with the then inadequate equipment, to verify or disprove the applicability of conservation laws to Compton scattering. Another such has now been carried out to verify that in Compton scattering, by a 13.8 mg/cm^2 Be foil of a well-filtered and collimated beam of 2.62-Mev quanta, the scattered quantum and recoil electron are emitted without delay and in the relative directions demanded by the conservation laws. Better angular resolution and statistics and fewer experimental uncertainties than in the previous experiments were obtained. The results are in agreement with simultaneity and the conservation of energy and momentum.

1672

DEUTERON-PROTON SCATTERING AT 10.0 MEV BY A COINCIDENCE METHOD. H. J. Karr, R. O. Bondelid, and K. B. Mather. Phys. Rev. 81, 37-48(1951) Jan. 1.

A description is given of a scattering chamber possessing several novel features. This chamber was applied to the determination of absolute cross sections for elastic scattering of 10.0-Mev deuterons by protons, over a range of angles from 45 to 160 deg in the center-of-mass system. Two independently movable proportional counters were connected in coincidence and set at appropriate angles with respect to the incident beam so that coincidences were recorded between deuterons entering one counter and their recoil protons entering the other. The scattering media were thin Nylon and polyethylene-terephthalate foils. Some comparison is made with the mhbw theory of Buckingham and Massey. (Proc. Roy. Soc. (London) A179, 133(1941); Phys Rev. 71, 558(1947)). (auth)

RADIATION EFFECTS

1673

Oak Ridge National Laboratory
DOSE RATES OF RADIATION FROM NATURAL URANIUM. T. E. Bortner. Oct. 13, 1950. 15p. (ORNL-740)

Rates of ionization of air at the surface of a thick disk of natural uranium, produced by the radiations from the uranium, were measured with an extrapolation chamber. The measured rate of ionization is a function of the atomic number of the material used as a collecting electrode. Using a carbon collector, the total rate of ionization of the air is 14.4 esu/cc/hr, reduced to standard temperature and pressure. With the alpha radiation filtered out, the rate of ionization due to the residual radiation (principally beta) is 0.24 esu/cc/hr. The measured values of ionization rates due to the filtered radiation, using seven collecting electrodes ranging in atomic number from that of beryllium to that of lead, were found to range from 0.216 to 0.504 esu/cc/hr. The experimental results obtained are such that a logarithmic graph of measured ionization rate versus atomic number of collector material is a straight line. (auth)

RADIOACTIVITY

1674

ANGULAR CORRELATION OF TWO PHOTONS EMITTED IN SUCCESSION BY Mg^{24}. Georges Charpak and Francis Suzor. J. phys. radium 11, 633-8(1950) Nov. (In French)

A coincidence setup is described in which one compact group of horizontal counters is placed above the source, while a set of end-window counters forms an umbrella-like structure below the source. The instrument was used for the determination of the angular correlation of photons emitted by Mg^{24} in the angle range 70 to 180 deg.

1675

BETA-ACTIVITY OF POTASSIUM. C. F. G. Delaney. Phys. Rev. 81, 158(1951) Jan. 1. (Letter to the editor)

While most measurements of the specific β activity of K tended to converge on a figure near 31 counts/sec/g of ordinary K, two recent determinations (Sawyer et al., Phys. Rev. 79, 490(1950); Smaller et al., ibid. 79, 940(1950)) put the activity as low as 28.3 ± 1.0 cts/sec/g. The work described here favors a larger value. A Geiger counter with a mica end window and an A-alcohol filling was used for the β measurements, its geometry being determined by a modified Ra(E+F) calibration technique. Ni-supported Ra(E+F) sources were placed, at regular time intervals, in contact with Ilford C2 plates, and the growth of the RaF α activity measured absolutely; the amount of RaE present at any time could then be deduced, and from its β activity, as observed with the counter, the latter's geometry found. Experiments with KCl and KBr of various origin resulted in a value of 32.0 ± 3 cts/sec/g of ordinary K.

1676

CONVERSION LINES OF RaC'. V. M. Serebrifskaya, N. V. Forafontov, and V. S. Shpinel'. Zhur. Eksptl'. i Teoret. Fiz. 20, 573-4(1950) June. (Letter to the editor; in Russian)

In a series of works, Latyshev et al. (e.g., Doklady Akad. Nauk S.S.S.R. 63, 511(1948); NSA 3-1030) have described a much indented line of internal conversion of the quantum 1414 kev on the K shell of RaC'. Bashilov et al. (Doklady Akad. Nauk S.S.S.R. 70, 793(1950); NSA 4-3800), working with a better β spectrometer, did not observe any such fine structure. The same negative result was obtained by the present authors, who used an instrument of high resolving power, involving a heterogeneous magnetic field of axial symmetry, constructed by one of the authors (Shpinel', Doklady Akad. Nauk S.S.S.R. 53, 801(1946)).

1677

DECAY OF Sb^{120}. J. P. Blaser, F. Boehm, and P. Marmier. Helv. Phys. Acta 23, 623-6(1950) Dec. 10. (In German)

Sb^{120} decays both by emission of a positron spectrum with an upper limit of 1.70 Mev, and by K-capture. Three γ rays with energies 0.90, 1.30, and 2.20 Mev are present. A plausible disintegration diagram is obtained from these data.

1678

GAMMA RAYS FROM THE DECAY OF N^{16}. C. H. Millar, G. A. Bartholomew, and B. B. Kinsey. Phys. Rev. 81, 150(1951) Jan. 1. (Letter to the editor)

N^{16}, produced in the cooling water of the Chalk River pile by the fast neutron reaction $O^{16}(n,p)N^{16}$, was used for a pair-spectroscopical study of the γ radiation accompanying the β decay of N^{16}. Two rays were found, 6.133 ± 0.011 and 7.10 ± 0.02 Mev, agreeing with energy values of two of the excited states of O^{16} reported by Chao et al. (Phys. Rev. 79, 108(1950)). The ratio of the intensity of the 7.10-Mev ray to that of the 6.133-Mev ray is 0.08 ± 0.02. Combining these results with data reported by other writers, it is deduced that, whereas the N^{16} ground state has a spin of 2 and odd parity, the 6.133-Mev level of O^{16} has a spin of 3 and odd parity, and its 7.10-Mev level also has odd parity.

1679

GUIDE TO RUSSIAN SCIENTIFIC PERIODICAL LITERATURE. Vol. 3, No. 8. John Turkevich and Ludmila Turkevich. Aug. 1950. 33p.

A translation is given of Angular Correlations of Short-Range Alpha Particles and Gamma Particles, L. A. Kul' chitski, G. D. Latyshev, and D. G. Bulyginski, Izvest. Akad. Nauk S.S.S.R. 13, No. 3, 331-9(1949). This is an amplified version of an article in Doklady Akad. Nauk S.S.S.R. 64, 57(1949). The former was abstracted as NSA 4-3213 and the latter as NSA 4-856.

1680

INTERNAL PAIR CREATION IN MAGNESIUM-24. W. Mims, H. Halban, and Richard Wilson. Nature 166, 1027-8(1950) Dec. 16. (Letter to the editor)

The simultaneous emission of three particles (a decay β ray and an electron-positron pair) from a Na^{24} source has been examined. A value of the pair-conversion coefficient for the

2.78-Mev γ line of Na^{24} was determined to be $(7.6 \pm 1.9) \times 10^{-4}$. This agrees well with the theoretical result predicted for an electric quadrupole. In further measurements the positrons were stopped in beryllium instead of plastic. A pair-conversion coefficient of $(8.25 \pm 1.05) \times 10^{-4}$ was obtained.

1681

NEW NEUTRON-DEFICIENT RADIOACTIVE ISOTOPES OF THE LIGHT RARE-EARTH REGION. Betsy Jones Stover. Phys. Rev. 81, 8-13(1950) Jan. 1.

In the light rare-earth region, seven new neutron-deficient radioactive isotopes have been produced by proton bombardment in the 184-in. cyclotron and the linear accelerator; their radiations have been studied by absorption-curve and magnetic-counter methods. The new isotopes and their half-lives are La^{134}, 6.5 ± 0.25 min; Ce^{133}, 6.30 ± 0.1 hr; Ce^{134}, 72.0 ± 0.5 hr; Pr^{130}, 120 ± 5 min; Pr^{139}, 4.50 ± 0.2 hr; Nd^{138}, 22 ± 2 min; Nd^{139}, 5.50 ± 0.2 hr. Additional data have been obtained for the isotopes Ce^{135} and Ce^{137}. (auth)

1682

THE RADIOACTIVITY OF F^{20}. II. R. M. Littauer. Phil. Mag. (7) 41, 1214-24(1950) Dec.

Experiments on the radioactivity of F^{20} are described which give the following results: 3.5% of the disintegrations go directly to the ground state of Ne^{20}, while the remainder leave Ne^{20} in an excited state of energy 1.63 ± 0.02 Mev. The best present estimate of the F^{20} mass is 20.00631 ± 0.00005, corresponding to a total energy release $F^{20}-Ne^{20}$ of 6.87 ± 0.07 Mev. A weak γ ray of energy 1.0 ± 0.1 Mev is also observed, but its allocation to the decay of F^{20} is not established. Gamma-gamma coincidence experiments limit the fraction of disintegrations which produce cascade γ rays to less than 2%, unless one of the rays has a lifetime longer than 10^{-6} sec. 10 references. (auth)

THEORETICAL PHYSICS

1683

DIRAC'S EQUATION IN A RIEMANN SPACE WITH AN ASYMMETRICAL METRIC. M. el Nadi. Phys. Rev. 81, 159-60(1951) Jan. 1. (Letter to the editor)

It has been shown (Randers, Phys. Rev. 59, 195(1941); Mosharrafa, Phil. Mag. 39, 728(1948)) that the equations of motion of a charged particle in an electromagnetic field take the form of a geodesic curve in a 4-dimensional continuum described by a certain metric. A 5-dimensional space is considered here, defined by the same metric, and the corresponding Dirac equation derived. Its three terms express, respectively, the relativistic, the nonrelativistic, and the second-order terms of the interaction with the electromagnetic field.

1684

A GEOMETRICAL MODEL FOR THE UNIFIED THEORY OF PHYSICAL FIELDS. J. I. Horváth. Phys. Rev. 80, 901(1950) Dec. 1. (Letter to the editor)

It is suggested that a unified field theory can be based on Finsler's geometry. In this geometry (a generalization of Riemann's) space can be regarded as a manifold of line elements defined along curves of the space. Such a cruve may be the world-line of an electron or nucleon by which the field is originated, the line element also having a physical meaning since the unit vector can be regarded as the velocity of the particle along the world-line.

1685

INFINITE INTEGRALS IN QUANTUM ELECTRODYNAMICS. D. C. Peaslee. Phys. Rev. 81, 107-9(1951) Jan. 1.

A numerical discrepancy in the results of various authors for the same divergent calculation is traced to differences in the treatment of divergent integrals. The difference is exhibited explicitly, and a standard convention suggested that corresponds to the regularization procedure of Pauli and Villars. Alternative methods of evaluation are criticized on this basis. (auth)

1686

THE MEANING OF THE D_C FUNCTION IN THE QUANTUM THEORY OF WAVE FIELDS. M. Fierz. Helv. Phys. Acta 23, 731-9(1950) Dec. 10. (In German)

A physical interpretation is given to the Stueckelberg-Feynman function D_C (Feynman, Phys. Rev. 76, 769(1949); Rivier, Helv. Phys. Acta 22, 265(1949)). It is used in a critical discussion of a convergent-field theory recently proposed by Heisenberg (Z. Naturforsch. 5a, 251, 367(1950)). (auth)

1687

NEUTRINO AND ANTINEUTRINO. G. F. Zharkov. Zhur. Eksptl'. i Teoret. Fiz. 20, 493-6(1950) June. (In Russian)

The construction of the invariant Hamiltonian of interaction between two spinor fields requires the introduction of certain magnitudes of a tensor character, of which one has been found by Fermi (Z. Physik 88, 161(1934)) in the shape of a vector describing the β decay of a nucleon as the double emission of an electron and a neutrino. This was followed by the introduction, due to Konopinski et al. (Revs. Modern Phys. 15, 209(1943)), of another vector which involves a substitution of an antineutrino for the neutrino in the mechanism of β decay, it being understood that, in the absence of physical differences between the two hypothetical particles, both descriptions are equivalent. It has since been pointed out, however, that this equivalence holds only as long as the masses of both particles are equal to zero. From this, certain writers (e.g., Lamsadze et al., Zhur. Eksptl'. i Teoret. Fiz. 19, 178(1949)) have concluded that the theory of β disintegration implies a fundamental difference between the neutrino and the antineutrino which must be reflected in the shape of the β spectra. By an analysis of the properties of the above tensorial magnitudes, the present author shows that a theory of β decay can be formulated in which no discrimination can be made between the two hypothetical particles.

1688

A NEW MEANING FOR GAUGE TRANSFORMATIONS IN ELECTRODYNAMICS. P. A. M. Dirac. Nuovo cimento (9) 7, 925-38(1950) Nov. 20.

The dynamical theory of the electromagnetic field in interactions with the Pauli-Weisskopf field is worked out with the states defined on general space-like surfaces in space-time. A method is used which allows general gauge transformations $A_\mu \rightarrow A_\mu + \partial S/\partial x^\mu$ with the function S arbitrary. A new assumption is then introduced which connects the gauge with the surfaces on which the states are defined. The Hamiltonian takes on a simplified form in which the interaction terms are of quite a different type from the usual theory. (auth)

1689

ON THE ANGULAR CORRELATION THEOREM. B. A. Lippmann. Phys. Rev. 81, 162-3(1951) Jan. 1. (Letter to the editor)

A theorem of the theory of the angular correlation gives, under certain conditions, the probability of a double transition as a function of the probabilities of the two successive transitions, with no interference terms appearing. On the other hand, quantum-mechanically, such a double-transition probability must contain interference terms only when it is not possible to measure the system in the intermediate state. It is shown that by a special choice of the z axis of quantization the angular-information experiment makes possible a determination of the intermediate state, and, therefore, the theorem of the angular correlation follows.

1690

ON BOUND STATES AND SCATTERING IN POSITRON THEORY. W. H. Furry. Phys. Rev. 81, 115-24(1951) Jan. 1.

The use of bound-state wave functions in calculations in positron theory is justified by the introduction of a new representation, in a certain sense intermediate between the Heisenberg and interaction representations. In the bound-state representation the definition of a stable vacuum state is possible only for a restricted class of external fields. Some attention is given to the problem of vacuum polarization, and it is shown that a very simple procedure accomplishes the charge renormalization with sufficient accuracy to be of use in certain scattering problems. The application to the scattering of radiation is discussed in some detail, in order to show the relation between the different points of view that may be adopted in problems of the coherent scattering by a bound electron and the "Delbrück scattering" by virtual electron pairs. (auth)

1691

ON THE FINITE DIMENSIONS OF THE ELECTRON IN FEYNMAN'S THEORY. Luigi A. Radicati. Atti accad. nazl. Lincei Classe sci. fis. mat. e nat. (8) 8, 232-4(1950) Mar. (In Italian)

Following Weisskopf's (Phys. Rev. 56, 72(1939); Revs. Modern Phys. 21, 305(1949)) and Sawada's (Progress Theoret. Phys. (Japan) 4, 275(1949)) ideas on the finite extension of the electron, an expression for the electron's self-energy is obtained which is logarithmically divergent. The divergence was eliminated by Feynman (Phys. Rev. 76, 769(1949)) by introducing an adequate relativistic cut-off factor. The present author indicates a simpler procedure serving the same purpose.

1692

A POSSIBLE OBJECTION TO A THEORY OF LIGHT. André Mercier. Helv. Phys. Acta 23, 863-4(1950) Dec. 10. (Note; in French)

The discrimination between zero-mass (light) and finite-mass (matter) particles, first introduced in relativity and later in statistics, implies that the photon, which is the only particle realizing quantized oscillators, does not obey the exclusion rule. If this is obviated by attributing a finite mass, however small, to the photon, the latter would still be denied the faculty of forming a Planck oscillator with a measurable frequency; thus, no equilibrium could be established between photons of equal frequency, a situation contradicting a law of Kirchhoff in the theory of light.

1693

QUANTUM THEORY OF NON-LOCAL FIELDS. PART II. IRREDUCIBLE FIELDS AND THEIR INTERACTION. Hideki Yukawa. Phys. Rev. 80, 1047-52(1950) Dec. 15.

General properties of nonlocal operators are considered in connection with the problem of invariance with respect to the group of inhomogeneous Lorentz transformations. It is shown that irreducible fields can be classified by the eigenvalues of four invariant quantities. Three of these quantities can be interpreted, respectively, as the mass, radius, and magnitude of the internal angular momentum of the particles associated with the quantized nonlocal field in question. Further, space-time displacement operators are introduced as a particular kind of nonlocal operator.

1694

THE QUESTION OF INTERMEDIATE STATISTICS. Henning Müller. Ann. Physik 7, 420-4(1950) July 20. (In German)

The possibility is discussed of the application of intermediate statistics to models consisting of various distinguishable kinds of Bose or Fermi particles. In the boundary case where all particles are distinquishable, the statistics obtained is evidently that of Boltzmann. (auth)

1695

RADIATIVE CORRECTIONS IN THE NON-RELATIVISTIC LIMIT. W. Thirring. Phil. Mag. 41, 1193-4(1950) Nov. (Correspondence)

In calculating radiative corrections to the Klein-Nishina formula it has been assumed by Corinaldesi and Jost (1948) and by Heitler and Ma (1949) that the corrections vanish in the nonrelativistic limit. All terms proportional to the second-order matrix element were interpreted as renormalization, which means defining the electron-charge by the Thomson formula. The question is whether Dyson's (1949) renormalization procedure, the only one of which the

consistency has been proved, leads to the same result, or whether there are finite corrections proportional to the Thomson cross section analogous to the case of the magnetic moment. It has been shown by Schafroth (1949), by direct calculation, that after renormalization the fourth-order matrix element vanishes for zero momentum of the incident photon. Proof that this holds in all approximations is presented.

1696

RELATIVISTIC QUANTUM THEORY FOR FINITE TIME INTERVALS. E. C. G. Stueckelberg. Phys. Rev. 81, 130-3(1951) Jan. 1.

If transition probabilities are evaluated for transitions occuring during a finite time interval, additional divergencies occur different from those commonly encountered for infinite time intervals. The expressions obtained can however be made convergent, if an indeterminacy of time is attributed to each epoch of observation. The method is applied to the emission of a photon by a free electron. (auth)

1697

REMARKS OF RELATIVISTIC QUANTUM MECHANICS. K. V. Roberts. Phys. Rev. 81, 158-9(1951) Jan. 1. (Letter to the editor)

A summary is given of the results of a classical approach to the interaction representation of Tomonaga and Schwinger, already briefly described in Phys. Rev. 77, 146(1950). A covariant and formally consistent scheme of quantum field dynamic is obtained by first extending the classical theory of Weiss (Proc. Roy. Soc. (London) 169, 102(1938), and then quantizing it by a generalization of the usual rules, both in the Heisenberg and the Schrödinger pictures. The interaction representation is a particular case of a general scheme, and lies between these two pictures. A remarkable feature is that although the theory must be stated in Hamiltonian form, according to the general rules of quantum mechanics, the S matrix and other quantities can be shown to involve only the Lagrangian. This suggests that one might look for a new kind of quantum mechanics, in which the Lagrangian replaces the Hamiltonian functions.

1698

THE SEPARATION OF THE ROTATIONAL COORDINATES FROM THE N-PARTICLE SCHROEDINGER EQUATION. C. F. Curtiss, J. O. Hirschfelder, and F. T. Adler. J. Chem. Phys. 18, 1638-42(1950) Dec.

By group theoretical arguments, it can be shown that a wave function ψ_μ^L, for a system of N particles corresponding to a total angular momentum quantum number, L, and a quantum number, μ, referring to the z component of angular momentum may be written as a sum of terms: $\psi_\mu^L = \Sigma_s D^L(R)_{\mu s}^* \chi_s^L$. The $D^L(R)_{\mu s}$ are the representation coefficients for the Lth irreducible representation of the three-dimensional rotation group, and are functions of the three coordinates specifying the orientation of the system of particles in space. The χ_μ^L are functions of the $3N-6$ coordinates specifying the relative configuration of the N-particle system. The set of coupled differential equations for the functions χ_μ^L is obtained explicitly. The special case of the three-particle system is discussed in detail. The present treatment is more directly usable than the previous discussions since the basic equations do not involve implicit relationships between the variables. (auth)

1699

SOME RELATIONSHIPS BETWEEN VARIATION PRINCIPLES IN FEYNMAN'S AND SCHWINGER'S FORMULATIONS OF ELECTRODYNAMICS. M. Cini. Nuovo cimento (9) 7, 911-18(1950) Nov. 20. (In Italian)

A study is made of the relation between two variational principles, viz., that used for the transition probability amplitude of a system under the action of a time-dependent potential and that established by Schwinger for the "reaction operator K." Some results already obtained by Dyson concerning the meaning of Feynman's method as an S-matrix method and the relationship between Feynman's and Schwinger's formulations of quantum electrodynamics are derived in a different way. In the case of a time-independent potential, both formulations give Schwinger's variational principle for "scattering amplitudes," already extensively used in scattering problems for phase-shift determinations. (auth)

1700

SOME REMARKS ON NON-LOCAL FIELD THEORY. D. R. Yennie. Phys. Rev. 80, 1053-61(1950) Dec. 15.

The S-matrix formalism introduced by Yukawa for nonlocal field theory is considered. For suitable types of nonlocal fields and interactions it is shown that the S-matrix is convergent through the second order of interaction. In the limiting case in which the nonlocal fields become local, it is found that the S-matrix formalism yields results inconsistent with the usual formalism unless a certain limiting process is introduced. The limiting process brings agreement between the two formalisms only through the second order of interaction; and the higher orders will, in general, disagree. Unfortunately, the limiting process also destroys the convergence of the S-matrix in the general case of nonlocal fields.

1701

M.I.T. Laboratory for Nuclear Science and Engineering THEORETICAL GROUP, p.199-202 of [SEVENTEENTH] PROGRESS REPORT; [JULY 1, 1949, TO JULY 1, 1950.] V. F. Weisskopf. July 1, 1950. 4p. (NP-1777(p.199-202))

Brief descriptions of the work being done in the fields of quantum electrodynamics and theoretical nuclear physics are given. In the latter field, the two- and three-body problems, n-p scattering, meson production, electron scattering by nuclei, angular dependence of nuclear scattering, proton and deuteron reactions, Breit-Wigner resonance formula, internal conversion, and neutron pickup in Be^9 have been investigated.

1702

TRANSFORMATION PROPERTIES OF FIELDS OF SPIN ½. A. Gamba. Nuovo cimento (9) 7, 919-24(1950) Nov. 20. (In Italian)

Generalizing a suggestion by Yang and Tiomno (Phys. Rev. 79, 495(1950)), the existence of 16 different types of fields of spin ½ is pointed out with reference to the transformation properties under a general inversion of space-time co-ordinates. The possibility of a universal Fermi-type interaction is discussed. (auth)

1703

THE UNCERTAINTY PRINCIPLE. L. Castoldi. Nuovo cimento (9) 7, 961-2(1950) Nov. 20. (Letter to the editor; in Italian)

Gamba has given recently a derivation of the uncertainty principle (Nuovo cimento (9) 7, 378(1950)). Another short way of deducing the same principle is shown here.

1704

WAVE EQUATIONS IN MOMENTUM SPACE. Maurice Lévy. Proc. Roy. Soc. (London) 204A, 145-69(1950) Dec. 7.

The nonrelativistic and relativistic wave equations of a particle are solved in momentum space for different kinds of fields. It is assumed that the potential, when defined in co-ordinate space is central; but the method applies also to more general forms of momentum space potentials. First, the general integral equations which correspond, in momentum space, to Schrodinger and Dirac equations are derived, and the angular variables separated. Then a general method of solution of these integral equations is given, which lies mainly on a transformation into a four-dimensional hyperspace. These results are (relativistically and non-relativistically) applied rigorously to the Coulombian field (hydrogen atom) and to the scalar Yukawa potential. A more general case is further investigated. In this, the momentum space potential can be expanded in a series of powers of the modulus of the momentum (this last application involves a cut-off procedure). A mathematical appendix deals with some properties of the hyperspherical harmonics (expecially the integral equation of these functions) and with the Fourier transform of some kinds of central potentials. (auth)